UNITED STATES ARMY

OCTOBER 1970

AVIATION DIGEST

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UNITED STATES ARMY AVIATION DIGEST

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ABOUT THE COVER

A CH-54A Flying Crane leaves a confined area during a training flight at the U. S. Army Aviation School, Ft. Rucker, Ala. Our thanks for the cover photo and the inside back cover photo to CW4 Bill C. Walton

The mission of the U. S. ARMY AVIATION DIGEST is to provide information of an operational or functional nature concerning safety and aircraft accident prevention, training, maintenance, operations, research and development, aviation medicine, and other related data.

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Articles, photos, and items of interest on Army aviation are invited. Direct communication is authorized to: Editor, U. S. Army Aviation Digest, Fort Rucker, Ala. 36360.

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VIEWS FROM READERS

CORRECTION

The back cover of the September issue carried a three-panel display of instructions for taking oil samples, including drawing oil by mouth. At the time this material went to the printer this information was correct in accordance with TB 55-6650-300-15. However, the new TB 55-6650-300-15, dated 5 August 1970 and received 15 September 1970, contains this statement: "Allow the tube to fill with oil. Do not use mouth suction. Some oils are very toxic and even poisonous."

Sir:

As everyone connected with Army aviation knows, the avionics portion of PMPs, PMIs and PMDs normally consists of a cursory check at best; most of the time it is not performed at all.

The PMPs, PMIs and PMDs published by AVSCOM for the most part state to perform inspection of avionics equipment in accordance with a TM 11-series manual. What usually happens is that when a crew chief or a PE crew comes to this item is that everyone says to himself the pilot will get that, so we have an operational check only and nobody checks cannon plugs, shock mounts, cable bundles for chafing, etc.

With the complex electronics equipment now appearing in Army aircraft a quick operational check is not sufficient. I believe that if the avionics inspection requirements were integrated into the airframe and engine checklist, it would serve to remind everyone just what is required. If this is not possible the avionics inspection requirements should be published in the same format as the airframe and engine checklist and be kept in the aircraft logbook also.

SFC Robert J. Grant
146th Avn Co (RR)
APO San Francisco 96530

• Your comments are appreciated and you can be assured this matter is under study at this time.

Sir:

In Vietnam in 1967 I witnessed two separate midair collisions involving aircraft participating in formation flights. In both instances rotor blade contact was the cause of the accidents and resulted in loss of life to all occupants of the aircraft involved. Since that time I have personally felt that close formation military flight was unnecessary and foolhardy. (The tactical advantage of this type flying maneuver in a combat zone is the only justification I can think of and that logic is at least questionable.)

But, regardless of my personal views, it apears formation flying is here to stay and on that basis I was impressed when I saw the helicopters at Ft. Sam Houston, Tex., with safety markings on the topside of the blade to permit aviators to readily identify the rotor disc area of another aircraft while in flight or on the ground. I subsequently heard that in Vietnam many units were painting the topside of one blade white for the same reason outlined above. Again I was impressed because it meant to me that the Army also recognized the inherent hazards of formation flying and was even taking steps to increase the safety of these flights. Then I arrived in Korea and find that no helicopters have topside blade markings, and I can't even find a directive, TWX or publication which authorizes the use of such markings.

So my questions are obvious. Is there an Army-wide publication for marking of blades? And if not, why not? I feel strongly that we should mark helicopter blades and the markings should be as standardized as the markings of an aircraft serial number.

MAJ Barry E. Fitzgerald
Hq, 377th Medical Company
(Air Ambulance)
APO San Francisco 96220

• The USABAAR Weekly Summary for 28 November—5 December 1969 contained this statement: "Four of the most recent (midair) collisions involved helicopters flying in formation. If you observe this simple tenet, you can prevent all helicopter formation collisions: 'Maintain at least two rotor diameters between aircraft!' Formations closer than two diameters serve no useful purpose!"

Change 2 to TB 746-93-2, dated 27 January 1970, contains instructions for standard conspicuity markings of Army helicopter rotor blades.

Sir:

I am writing in regard to the article "Command Supervision Plus Team Effort" in July 1970 AVIATION DIGEST.

Under the units in CONARC that have had accident-free periods of a year or more, the 8th Squadron, 1st Cavalry is listed as having had an accident-free period of 1 year 6 months.

According to the records available to this office, the period of time should have been 2 years 3 months. The only accident recorded here happened on 16 April 1970 and involved an OH-13E. The unit was organized in August 1967 and the first aircraft received was an OH-6A on 3 January 1968.

LT Frederick H. Panhorst
Hq, 8th Sqdn, 1st Cav
Ft. Knox, Ky. 40121

• The accident-free period for the 8th Squadron, 1st Cavalry was derived from information contained in letter, ATOPS-AVN, Hq, USCONARC, 22 January 1970, subject: "Army Aviation Accident Experiences," which stated that the unit experienced an accident in June 1968. The period covered in the article was 1 July 1968 through 31 December 1969. Congratulations on your fine record!

Ranger Operations

The role of Army aviation during Ranger operations is as demanding of the aviator as it is of the Ranger. The MACV Recondo School in Vietnam has helped make both jobs easier

Captain Johnny Durden and CW2 Fred Sherrill

ONE OF THE toughest jobs being performed in the Republic of Vietnam is that of long range reconnaissance. Until recently units performing this mission were called LRRPs, an abbreviation for long range reconnaissance patrol, or more affectionately "LURPS." On 5 December 1968 General William C. Westmoreland, Army Chief of Staff, directed that the word Ranger would replace the term LRRP when referring to long range patrol companies. In order to provide the men of these units and the rest of the Army with a "common regiment identifying an uncommon skill" the 75th Infantry (Merrill's Marauders) was activated on 1 January as the parent regiment for all active Army Ranger companies.

Just as did Rogers' Rangers during the French and Indian War, today's Ranger partols of the 75th Infantry procure intelligence by scouting enemy forces, positions and taking prisoners.

Such patrols are airlifted into an area to pinpoint the enemy's location and strength without being detected. Providing up-to-date in-country long range reconnaissance patrol training is the Military Assistance Command Vietnam (MACV) Recondo School. The mission of the school is two-fold: First, to train selected U. S. Army, Marine, Navy and allied personnel in long range reconnaissance techniques. Second, to conduct long range reconnaissance operations in assigned areas of operations. The school, organized in 1966 and staffed by the 5th Special Forces Group (Airborne), has trained more than 5,000 men in the necessary skills of long range reconnaissance.

The MACV Recondo School is supported by the 281st Assault Helicopter Company of the 17th Aviation Group (Combat), which provides one platoon of UH-1H slicks and UH-1C gunships. To the men of the 281st the term LURP has a special significance.

Once the student arrives at the school he immediately starts his training. This includes everything from physical training at 0500 hours each morning to rappelling by rope from hovering UH-1s.

During the first week students receive classroom training in tactics used during long range reconnaissance operations. Instructors explain what type of landing zones to pick. For example, one that is at the top of a hill initially gives the team the advantage of holding the high ground.

Instruction also covers all phases of long range reconnaissance insertion procedures. For instance, students are taught the best time for insertion and how to pick a vantage point from where to observe routes of travel.

During the second week outdoor training is combined with classroom work. On the second day the students are taken to a large rice paddy area where they are trained in the use of the helicopter. Instruction includes procedures to follow in the event the aircraft is shot down or has an accident. They are shown how to shut off fuel and electrical switches, remove radios and zero out the frequencies in the consele in case the pilots are unable to do so. They also are taught the priority for evacuation of personnel from a downed aircraft.

Next, the students are familiarized with rappelling and extraction equipment stowed in the back of the helicopter. There are three 120-foot nylon ropes which have three special seats made from cargo straps. These are named McGuire rigs after their inventor, Sergeant Major McGuire, who was a member of the 5th Special Forces Group.

The seats are used to bring teams out of areas where helicopters are unable to land or where ladders cannot be used. The ropes also may be used by the teams to rappel into their area of operation or by the recovery sergeant in case of an accident.

The ladders are 30 feet long and hang down from each side of the aircraft. They are used for

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The McGuire seat is used to bring Ranger teams out of the jungle where helicopters are unable to land

Ranger Operations

both insertion and extraction of teams when the landing or pick-up zone is not suitable for a low hover or touchdown. Ladders enable the team leader to pick a landing zone which otherwise would be totally unsuitable for a normal landing—giving the team a better edge on Charlie by letting it enter an area less likely to be expected as a potential landing zone.

Ground classes are followed by actual practice in conjunction with training aviators newly assigned to the 281st Assault Helicopter Company. The pilots hover a UH-1 out-of-ground effect as students climb up one side, go through the cargo compartment and back down the other side of the aircraft. To the pilot this is quite an experience as the different body weights and movement of the students on the ladders continually changes the aircraft's center of gravity. It's just about like learning to hover all over again.

At the next station the students learn how to rappel from the aircraft and again a newly assigned aviator is at the controls. Six ropes are used for rappelling instead of the three mentioned before to speed up training. The new pilot experiences problems involved in hovering the aircraft 120 feet in the air and at the same time maintaining altitude and holding the aircraft over one spot.

At the next station students are taught how to ride in the McGuire rigs. For the aviator this is probably the hardest of the three maneuvers he is learning. The McGuire rigs are fastened to to the center of the aircraft in the cargo compartment and protrude from the left-hand side. Three students are placed in McGuire rigs below. With the center of gravity to the left-hand side, the pilot must lift the students vertically before starting his forward movement. If he doesn't the students will be dragged along the ground or in actual emergencies into the trees.

Once the aircraft is in the air the pilot must hold his air speed between 40 and 60 knots indicated. The most difficult part is the landing. The approach must be terminated at an altitude of 130 feet before the students are lowered to the ground. If the approach is made too low the students will be hurled into the ground. If it is too fast the students will begin to oscillate as the aircraft flares. This also could result in dragging them into the ground.

For those who might wonder why the McGuire rig ropes are not run through the cargo hook, the reason is simple: the ropes could not be cut in case of an emergency. A rope could become entangled in trees and since each has been tested to 5,000 pounds a helicopter could be pulled down before the pilot could take corrective action. Or in the event of an engine failure it would be better to cut the ropes to free the team members who otherwise would be dragged on the ground or through the trees in a high-speed deceleration.

A UH-1 in Vietnam normally has a crew of four: pilot, copilot, crew chief and gunner. However, in long range reconnaissance operations each aircraft has an additional crew member called the bellyman. It is his job to guide the aircraft over the teams on the ground and to cut the ropes in case of an emergency. He also operates the ladders and,

since he is a trained medic, he administers to the wounded men's needs.

With the completion of this phase of training—commonly called Black Tuesday by the pilots in the 281st—the teams are taken to an island in the Gulf of Nha Trang where they spend the remainder of the week practicing classroom work in the great outdoors. The students are boken down into six-man teams with American students and seven-man teams with Korean and Thai students. Team leaders are selected by rank and the chain of command is established down to the last man. Then they practice the types of patrols they will use, how they will sleep and stand guard and how they will post themselves when they stop for radio contacts. On Sunday the aviators again join them.

The last week involves the secondary mission of the Recondo School. Each team is assigned an area of operation covering some 10,000 to 20,000 square meters and each pilot takes three or four teams. An operation order is assigned each team. To minimize the amount of time spent in the area, the mission commander selects primary and alternate landing zones in advance.

During the entire operation the pilots keep the same teams and all crews remain intact. The pilot and copilot attend the briefing of their assigned team. Here each member tells the instructor what this particular team will be doing, what the mission is, the last enemy action in the area, what time radio contacts will be made, the route of march, how they will sleep, where survival equipment is located, who is carrying the emergency radio and in what pocket it is located. The instructor also is advised what escape and evasion route will be used in case two radio contacts in a row are missed or if for some reason the team is split up.

After each team member has completed his briefing the pilot has his turn. He explains the type of flight and emergency procedures. He also advises in what direction he will be landing and whether or not the landing will terminate in a low hover, ladder or set down. Then the fire team leader explains what to do in case of enemy contact, gives his call sign and advises how to direct fire on the enemy by using the clock method. After this the time for the insertion is given, either late evening or early morning.

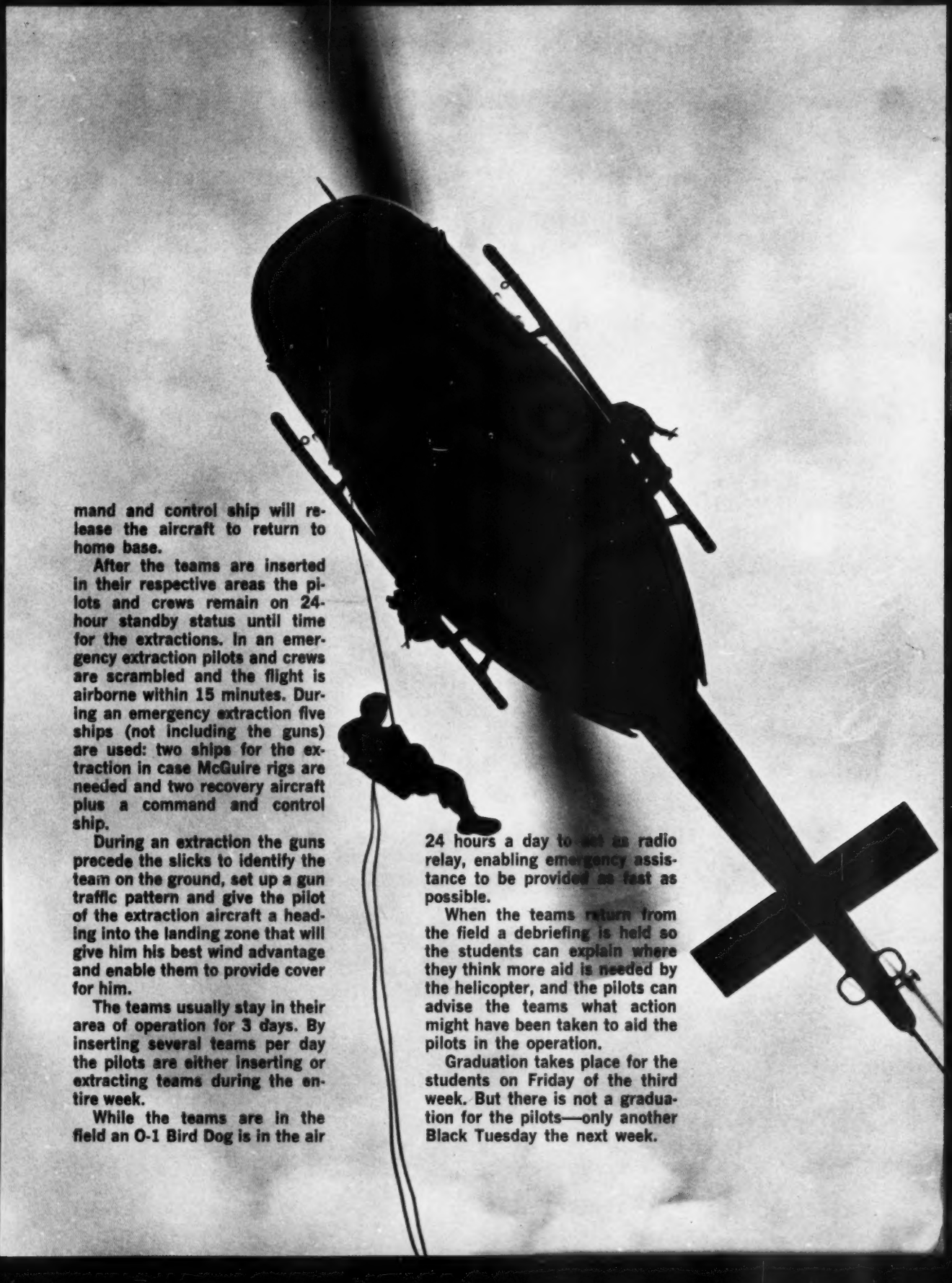
As stated, this school also is used to train aviators and aircraft commanders newly assigned to the 281st. An aircraft commander undergoing training sits in the left seat and makes all the decisions, such as which landing zone will be used, what alternate and where the probable pickup point will be. An experienced aircraft commander is in the right seat acting as pilot. His duty is to point out from experience better or easier ways of accomplishing the mission.

The formation which is used by the 281st for this type of operation is called a Delta formation. The first ship in the formation is the command and control aircraft. It is followed on the right by the second recovery aircraft; the next helicopter is the primary recovery aircraft. Their configuration and position is never changed. On the left side are the team ships which vary in number depending on the number of teams to be inserted. Behind this formation is a light or heavy fire team, depending on the situation.

Two recovery aircraft are used in this type operation for safety because in the event an aircraft is lost during an insertion a single recovery aircraft could not extract the crew of five and six team members. The fifth crew member in these aircraft are also medics.

The command and control aircraft carries the air mission commander and the commander of the school so that in case of an emergency decisions can be evaluated and made immediately without having to explain the situation over the radio—a situation that increases the possibility of a misunderstanding occurring.

For team insertions the air mission commander is guided by the aircraft commander of the team being inserted. When the flight is positioned over the area of operation the aircraft commander requests a release which is approved by the air mission commander if the situation permits. At this time his aircraft leaves the formation to accomplish the insertion; all other aircraft hold their positions in the flight. If the pilot cannot insert the team in the primary or alternate landing zones, the com-



mand and control ship will release the aircraft to return to home base.

After the teams are inserted in their respective areas the pilots and crews remain on 24-hour standby status until time for the extractions. In an emergency extraction pilots and crews are scrambled and the flight is airborne within 15 minutes. During an emergency extraction five ships (not including the guns) are used: two ships for the extraction in case McGuire rigs are needed and two recovery aircraft plus a command and control ship.

During an extraction the guns precede the slicks to identify the team on the ground, set up a gun traffic pattern and give the pilot of the extraction aircraft a heading into the landing zone that will give him his best wind advantage and enable them to provide cover for him.

The teams usually stay in their area of operation for 3 days. By inserting several teams per day the pilots are either inserting or extracting teams during the entire week.

While the teams are in the field an O-1 Bird Dog is in the air 24 hours a day to act as radio relay, enabling emergency assistance to be provided as fast as possible.

When the teams return from the field a debriefing is held so the students can explain where they think more aid is needed by the helicopter, and the pilots can advise the teams what action might have been taken to aid the pilots in the operation.

Graduation takes place for the students on Friday of the third week. But there is not a graduation for the pilots—only another Black Tuesday the next week.

Your Door Gunner READS . . .

POTPOURRI

Aircraft crashed while performing a night surveillance radar approach. The aircraft touched down 1,100 feet short of the runway. Primary cause: pilot error in that he allowed his aircraft to touch down 1,130 feet short of the runway threshold. Contributing cause: the pilot exercised poor judgment in using a pair of tinted, non-issue, personal, bifocal eyeglasses of a configuration that was not suited for use while flying. [For more on sunglasses see "Aeromedic" in the April issue of the AVIATION DIGEST.] The use of these glasses compromised the pilot's ability to safely land the aircraft.

President Richard M. Nixon recently awarded Master Army Aviator wings to Chief Warrant Officer Leroy Brendle at San Clemente, Calif. CW4 Brendle is a 23-year veteran of the Army with over 15 years experience as an Army helicopter pilot. He served as a CH-47 Chinook pilot in the Republic of Vietnam in 1966-1967.

Captains William H. Clark, M.D., USAF MC, and J. Howard Stokes Jr., M.D., USA MC, are involved in a pioneering venture at the U. S. Army Aviation School, Ft. Rucker, Ala., by using television as a medical training device for student flight surgeons studying ophthalmology (study of the eye) and cardiology (study of the heart) [see article on page 24].

CPT Clark is a graduate of the University of Missouri Medical School and is assigned to the Aviation School as part of the interservice medical program. He is an instructor in cardiology at the Department of Aeromedical Education and Training (DAET).

CPT Stokes, a DAET instructor in ophthalmology, is a graduate of the Medical College of South Carolina, Charleston, and has done resident work in ophthalmology at Wills Eye Hospital, Philadelphia, Pa.

Instrument Corner

Q. Can I file to a no PT (no procedure turn) fix?

A. Yes, if you have the capability to identify the fix. Preflight item 13c specifies that the last fix entered (IFR) in the route of flight section DD Form 175 will be the **one** which **the pilot intends to use** for an instrument approach to the destination airfield. It should be clearly understood that by filing to a no PT fix and in the event of lost communications **that approach which is served by the no PT fix must be made.**

Q. What is the story on rotary wing only aviators logging copilot time in fixed wing aircraft?

A. Effective 1 July 1970 rotary wing only aviators are no longer permitted to log copilot time in fixed wing aircraft for the purpose of meeting annual minimums.

Alaskan Mercy Mission

Specialist 5 Pat Sheeran

HAMPERED by heavy overcast for more than 30 hours, an Army UH-1D Huey helicopter pilot made a dramatic flight on 28 June 1970 to rescue a sick mountain climber stranded on the 15,000-foot level of Alaska's Mt. McKinley.

CW4 Ronald I. Smith admitted he was surprised by a sudden clearing in the overcast around Mt. McKinley—a lucky break which allowed him to rescue the man and fly him to an Anchorage hospital.

The rescue climaxed several search attempts in bad weather to pick up Tom Kensler, who had become seriously ill with a respiratory ailment while his party scaled North America's highest mountain.

CW4 Smith, flying a Huey from U. S. Army Alaska's 19th Aviation Battalion, Ft. Richardson, said he and an Air Force pararescue medic had been braving bad weather since the day before. But suddenly he saw a small clearing as he neared the mountain.

"I approached it cautiously and didn't want to take any chances, but actually it came off with no problems whatsoever," said Smith, who has been a helicopter pilot for 13 years.

Once he got beneath the overcast the mountain was clear and the weather calm. The dramatic pickup was at the 15,000-foot level of the 20,320-foot mountain.

"The party looked like it was on the move across the (Harper) glacier," Smith recalled. "When they spotted us, they marked a level spot right next to the path . . . it was a good area." The other

u.s. army aviation displays its versatility once again in a daring rescue mission in alaska

climbers continued their attempt to climb the mountain as the helicopter whisked Kensler some 150 air miles to an Anchorage hospital.

The rescue operation began early the day before when the Rescue Coordination Center at Elmendorf Air Force Base asked the 19th Aviation Battalion to make the rescue. Smith and the Air Force pararescue medic from the Alaskan Air Command at Elmendorf, Staff Sergeant Jon H. Young, flew two missions the first day but were foiled by bad weather shrouding the mountain.

According to Douglas Bingham, president of the Alaska Alpine Club, the six mountain climbers had been on the mountain 2 weeks and had camped Friday night just below the 18,000-foot level. Later that night Kensler said he became "very violently sick" with nausea and had difficulty breathing. The other climbers originally thought Kensler had pneumonia and radioed for help. A Fairbanks doctor consulted by radio with the party.

The group transported the man on a sled made of skis and snowshoes to the 15,000-foot level where he could breathe easier—and later be rescued by the Army helicopter.

The Rescue Coordination Center, which had the overall responsibility for the joint service rescue, reported the operation totaled 27 sorties and 24.3 air hours. Another helicopter joined the rescue the second day. It was piloted by Army Major Alexander Russell. Also on board the second Huey were copilot CW2 Michael Wickware and crew chief SP5 Thomas Jannausch.

Left: Mt. McKinley, rising to a height of 20,320 feet, stands as a challenge to individuals who seek to reach its summit. Below: Tom Kensler sits in the rescue helicopter. His rescuers are (from left to right) Air Force SSG Jon H. Young, pararescue medic; CW4 Ronald I. Smith, the helicopter pilot; and MAJ Alexander Russell, the pilot of the support helicopter

#1 Lay map flat, north at top, face up . . .
N1
. . . fold map in half
N1
N1
#2 Crease each half into three equal parts parallel to center fold just made . . .

DURING MY LIMITED and somewhat trying career as an Army aviator, I've learned, like many before me, that the best source of information is the "grapevine," better known as the chain of command. Information flows from Senior aviator to student pilot and back again in a never-ending stream of knowledge. All aviators encounter and relate many problems daily, some of which are specifically related to a particular aircraft class and type, and others which pertain to aviation particulars that every pilot is likely to experience sometime during his career. Having been recently counseled and enlightened on one of those so-called common problems by a Senior aviator, I would like to share my findings with fellow aviators and make my contribution to that valuable grapevine.

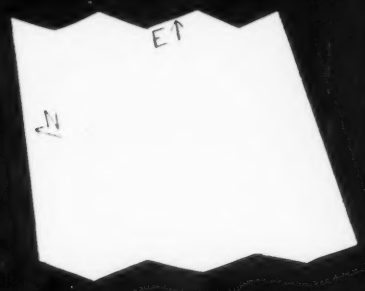
Most publications used for instrument flight and radio navigation are not only designed for quick reference but are also physically small and easy to use in the cockpit. Most charts used for instrument flight come prefolded for systematic use in a limited-space compartment. But, what about visual flight publications and more specifically charts used in a tactical or less formal situation that an aviator might encounter while flying missions outside the continental United States?

How about the aviator who must navigate by reference to a tactical or geographical type chart using the pilotage method? He must be, as they say, outside as well as inside the cockpit with his head on a good swivel using an unfolded 33 x 40 inch, 1:50,000 scale tactical chart wadded or stuffed in his lap in an already cluttered cockpit. How many ways do you know of folding a chart for quick and easy reference, small enough for storage in the pocket of your flight suit and efficient enough to provide an excellent tool for visual navigation?

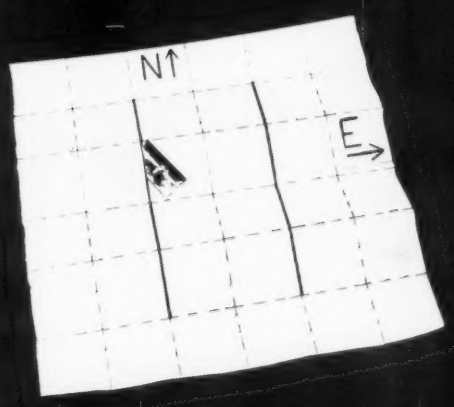
THE TACTICAL MAP AND YOU...

CW2 Nile L. Harter Jr.

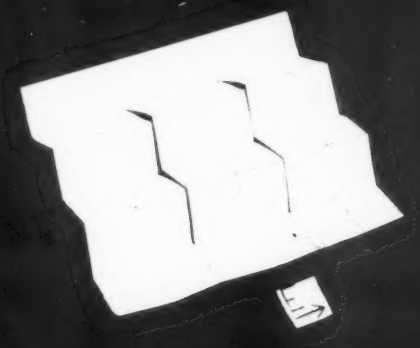
#[illegible] map face up, east at top . . .



fo[illegible] half turning top edge down to [illegible] bottom edge and then [illegible] step #2

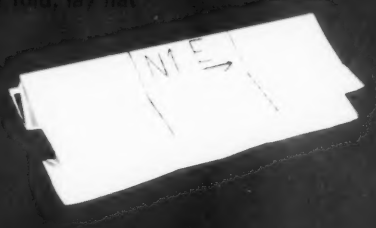


#[illegible] map, lay flat north [illegible] with sharp blade neat[illegible] along heavy lines (dot[illegible] represent folds made)

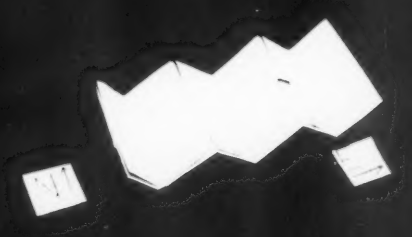


#5 Disregarding cuts, using folds previously made, fold into parallel east and west sections

. . . open to center fold, lay flat



#6 Disregard cuts, using folds previously made, fold into parallel north and south sections



. . . open to center fold, lay flat

#7 Turn map over as it is now folded and using a single strip of tape form a binder (tape) as illustrated

#8 Turn map over and using taped folds as a binder (step #7) you should now have a three-section, two-page book-map

#9 To finish the book-map for use, tape or glue the eight places where the edges you have cut come together (two places at each arrow)

#10 If the map has been properly folded, cut and tape, you will find that there are not only three usable sections from east to west but each of these sections can be folded north to south as desired. There are three usable sections folding north and south within each usable section folding east and west.

Following step #10 your book-map should be ready for use; however, the addition of cardboard covers and gluing down of loose corners will prolong service and add to the durability. With little practice you will be able to navigate with ease to any given point on the map by simply folding or turning sections north, south, east and west.

The first step in making a good preflight is research. Knowledge of technical manuals, technical bulletins, modification work orders and historical records are a necessity for a thorough preflight

THE FIRST STEP. . .

Research

Captain Robert G. Skinner

THE 1-to-1 vertical vibration was becoming more and more pronounced as the UH-1C bore further into the early morning mission. The crewmen ruled out turbulence as the cause for the increasing vibration although they were flying in the jungle covered mountains of the Central Highlands in the Republic of Vietnam where turbulence is usually present.

When it was decided the problem was mechanical, the aircraft commander immediately alerted the lead gunship and the reconnaissance aircraft of the situation and stated he was electing to abort the mission and land to conduct a thorough inspection of the aircraft.

No, the aircraft did not crash. It landed intact with the crewmen alive, but shaken. They were literally shaken since, after executing a 180-degree turn toward the airfield, the vibration increased to such an intensity that on final approach the aircraft was bouncing and vibrating so violently the pilots had to lock their shoulder harnesses to remain seated and fly the aircraft. To their surprise the aircraft hovered smoother than the crew could ever recall a heavily loaded UH-1C gunship hovering.

Could it be the crewmen were relating this relatively smooth hover to the shaking experience they had just been through, or maybe they were so happy to be close to terra firma again that the vibrations were ignored. Possibly the increased load on the rotor system did smooth out the vibrations. Whatever the reason, when the collective was decreased to land from a hover the aircraft again began vibrating and bouncing violently. As the crewmen's excitement from being back on solid ground wore off, they were able to turn their attention once again to the disturbing flight conditions they had just encountered.

After the rotor system stopped turning and the aircraft finally quit rocking, the crew began a close inspection of the aircraft. The first complete postflight inspection revealed everything was apparently in order. Since a vertical vibration is associated with the main rotor system, a concentrated inspection was performed on the main rotor head and the related flight control systems. Still nothing.

"Wait, doesn't the mixing lever look shiny where the control tube from the scissors is attached to it?" questioned the aircraft commander.

After close inspection the crew chief discovered that the bolt appeared loose, but he couldn't turn it with his fingers (figure 1, page 17).

Operations was notified and a maintenance aircraft was dispatched to the forward airfield. When it arrived with the appropriate technical manuals, a technical inspector, tools and repair parts, the maintenance officer went into a long dissertation about performing proper daily and preflight inspections. He insinuated these inspections had not been performed or had been performed improperly on this aircraft when, in fact, a thorough preflight had been performed. It was a unit policy to make preflight inspections and a runup of the aircraft after first light each morning and to report all findings immediately to operations and maintenance. These all had been completed on this aircraft that morning.

Meanwhile, the technical inspector had disassembled the control tube from the mixing lever and confirmed the crew chief's earlier suspicions. He then replaced the control tube and bolt with new ones and announced the aircraft was mission ready. However, no one had investigated to determine the cause or test flown the aircraft.

Since the bolt was cut approximately halfway through (figure 3) and the hole for the bolt in the control tube was enlongated until it only lacked about ⅛ inch before working loose completely (figure 2), don't you think the reason for this should have been investi-

gated—especially when one considers that the aircraft had only 2 hours flight time logged since the unit received it from higher maintenance? If your answer is yes, you are in agreement with the crewmen. They refused the aircraft for their mission.

Hearing of this, the maintenance officer asked them to fly it directly to base camp. Again, the answer was no. So, he and the technical inspector elected to fly it back and let the former crew fly the maintenance aircraft back.

Before accepting the maintenance aircraft for flight, the pilots preflighted it; after receiving the lecture on this subject, they knew this was a must before each flight. Ironically, the aircraft commander found the same type bolt on the very same color coded mixing lever of the UH-1H loose enough to be turned with his fingers. Now maintenance had a twofold problem: two aircraft with the same problem and they both had to be taken to base camp for repair.

Our crew got a lift back to base camp by a reconnaissance aircraft. Another gunship was preflighted and found to be satisfactory, so the mission was resumed and completed with no further mishap.

We still were curious about what caused the control tube to cut into the bolt or vice versa (they were both badly worn), so we later met with the maintenance platoon leader, a very dedicated and capable person. Through researching all appropriate technical manuals, modification work orders and technical bulletins published for this particular aircraft and cross referencing these with the logbook and the aircraft historical records, he was prepared to explain the situation and attempt to answer the crew's numerous questions. He even called on a technical representative from the aircraft manufacturer to assist him with the very detailed explanation.

While in maintenance in CONUS the entire aircraft was rebuilt. When the new 540 main rotor head was installed, the bolts which attach the control tube from the scissors to the mixing lever were not torqued properly, thus causing the rapid wear.

Since the components were all new when installed and the aircraft had very few flight hours logged from the time of installation, this shows how fast these items can wear when not properly assembled.

The correct method to follow when torquing these particular bolts is very easily overlooked when following the technical manual; in fact, most people who have been in aviation for only a few years probably have been in error without realizing it for this same reason whether they are pilots, crew chiefs or mechanics.

Have you ever researched an item and found that the specifications or tolerances change with given aircraft serial numbers? You probably have and this is where you and every other individual dealing with aviation on any level can make a big mistake if further investigation and researching is not continued. These specifications and tolerances are valid for those given serial numbers when the aircraft was manufactured and assembled. But how valid are they after the aircraft has compiled several hundred flying hours and the components have possibly been replaced or modified? Also, technical bulletins may have been published altering tolerances or specifications.

If an aircraft has had a component installed on it that is standard on later serial numbered aircraft, the data being researched could well be contained in that series of serial numbers although different from the one on the tail of the aircraft. It is also possible to have an older component than the aircraft you are connected with. This makes it imperative that any time one is confronted with this situation the aircraft historical records are cross-checked with the appropriate publications to ensure that proper data is obtained. Apparently these necessary steps were not taken on the aircraft in question because the torque settings on the bolts matched the data given for its serial number. However, when the aircraft historical records were cross-checked it was revealed that the 540 main rotor head required a much higher torque setting. This of course meant that the bolts had been extremely undertorqued.

You are probably wondering why the crew chief could not turn the bolt by hand if it was so greatly undertorqued. Even though it was torqued at the lower torque setting, it was much too tight to turn with his fingers yet not secure enough to prevent the parts from vibrating, rotating and wearing into each other when placed under the tremendous stress and pressure created by the main rotor system in flight.

The reason the pilot could rotate the bolt on the UH-1H model was twofold. First, the bolt on a UH-1H is much smaller than the one on the UH-1C 540 rotor head due to the different basic principles of operation of the two. Therefore, the torque setting on the bolts for the UH-1H main rotor head is much less than that required for the UH-1C model 540 main rotor head, including the earlier 540 model head which required less than the newer ones. Second, the blade grips (which contain oil) on the UH-1H model were seeping around the seals and oil was being thrown all over the main rotor head, thereby providing lubrication around the bolt and allowing it to turn much more easily. Regardless of the reasons, the bolts on the H model are not supposed to be loose enough to turn by hand. In this case they also were undertorqued which

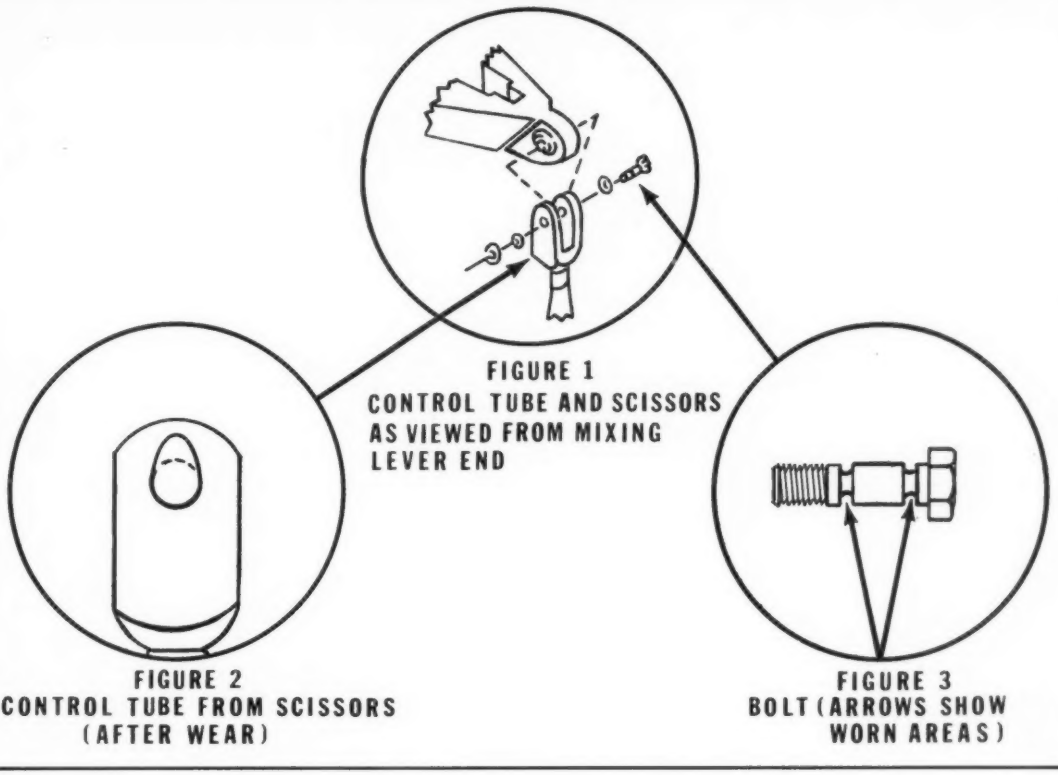


FIGURE 1
CONTROL TUBE AND SCISSORS AS VIEWED FROM MIXING LEVER END

FIGURE 2
CONTROL TUBE FROM SCISSORS (AFTER WEAR)

FIGURE 3
BOLT (ARROWS SHOW WORN AREAS)

would ultimately result in the same type wear that the UH-1C model experienced.

If the bolt or the control tube were completely worn through or worn to the point they could not sustain the pressure exerted upon them, the pilot would have absolutely no cyclic or collective control over the corresponding blade. This would permit the blade to adjust to independent pitch settings with the other blade still under pilot control. The extreme end result of this condition would be absolute loss of control and possible destruction of the aircraft by the rotor system before a landing could be made; therefore, it is imperative these components function properly.

For those of you flying, maintaining or inspecting this type aircraft, it will be of the utmost importance to know what to look for on your inspections in order to detect the deficiency. The technical representative from the manufacturer explained to the crew that these bolts usually can't be rotated by hand even though the torque setting is not proper.

If the bolt is undertorqued and the components are rubbing against each other, an inspection of the bolt and washers probably will reveal what appears to be graphite in the crevices between them. This buildup is actually metal particles from the components caused by friction of the metal surfaces against each other. He further explained that an apparent graphite deposit (metal particles) is a good indication of metal deterioration on any component of any aircraft.

It doesn't matter whether you fly, maintain or inspect, if you encounter this situation further investigation is necessary.

When you research the tolerances or specifications of any item in a technical manual, don't stop researching when you see them change for certain serial numbers. Always cross-check the aircraft technical manuals, technical bulletins, modification work orders and historical records when this situation presents itself or any time you are in doubt. If you need assistance on how or when to do this, your unit maintenance officer or technical inspector will be able to help you.

A little more effort and research may save a life, maybe yours. Aviation is a profession, so act and be professional.

MEDICAL ASPECTS OF YOUR LIFE SUPPORT EQUIPMENT

Provided by the Society of U. S. Army Flight Surgeons

Aeromedic

To the air crewman: Most air crewmen think about life support equipment in terms of oxygen masks, environmental control systems, G-suits and the like. Army aviation with its vast helicopter fleet does not require many of the classic life support equipment items.

The Army aviation equipment inventory includes many items that are uniquely *life support* equip-

ment, regardless of official supply classification. Many have been designed specifically for the helicopter or "low and slow" environment of Army aviation.

As the phrase life support implies, these items have more than a utilitarian function. They were designed primarily to save your life or support your physiologic needs during the execution of your flying mission.

Some of this equipment must serve a dual role. Fire resistant flight suits are an example. The suit may wear out before it has to provide its primary life supporting function. This dual role creates design problems. A fire retardant fabric may not be durable, comfortable, acceptable in weight or easily tailored. Fabrics that naturally meet the comfort and wear requirements may provide no thermal protection.

There are other examples. Jet aircraft oxygen systems may not be compatible with helicopters and Army airfield logistics. Sunglasses must be resistant to impact, compatible with the helmet, free of distortion, resistant to scratching and not restrict the visual fields. Gloves must be fire resistant, cool, thin enough to transmit tactile sensations, durable and remain unharmed by exposure to petroleum products.

Since these items relate to your well-being, your flight surgeon is intimately familiar with the technical aspects of each piece of equipment. His job is PREVENTION. Prevention of aviation environment induced injuries and illness through design and instruction in the use of protective equipment is one aspect of his duties. This requires specialized medical input just as does the prevention of malaria by drugs.

Just what are the medical aspects of the more familiar life support equipment items? Your flight surgeon can supply details only touched upon or omitted here.

SPH-4 helmet: Over 35,000 copies of this advanced design have been procured for Army aviation, enough for everyone. Compared to its predecessors, it's lighter (3.4 pounds regular size), cooler and easier to fit because of the sling suspension. Because of the weight reduction and lack of pressure points, it is better tolerated for long periods of wear.

It is safer because it won't come off your head unless it literally comes apart—try it. A blow with 55 foot-pounds of energy won't mark it. Its sound protection is unmatched. Audiophiles will appreciate its 50 decibels (db) of noise attenuation at 4,000 cycles per second frequency and 42 db average attenuation across a 500 to 8,000 cycle range. That will save a lot of hearing. It's so good there is no reason to wear earplugs as long as the helmet fits properly.

Some complain that they can't hear the snap of a bullet or engine noises while wearing the SPH-4. This is not true. Unless your hearing is already damaged, the SPH-4 will only alter a sound's pitch. If the sound desired to be heard is so quiet that it is completely attenuated, then it couldn't be heard with the helmet off in the presence of any background noise.

Hearing these sounds is a matter of experience and perception based on an awareness of what to listen for. Most complaints have come from experienced aviators making a helmet change in the middle of a Vietnam tour. Once their perception changes to the altered pitch and they reduce intercom volume, they discover they actually hear better. If they don't, chances are some permanent hearing damage has already occurred.

Nomex flight suit: Fire produces nasty injuries. Postcrash fires are by nature emotionally hideous. Advancing textile technology is producing a wide range of fabrics that can dramatically reduce the burn hazard.

Your Nomex flight suit is an example. Properly worn and fitted in association with leather or Nomex gloves, leather boots and helmet with visor lowered, it can bring you through a significant fire exposure with minimal injury.

The cotton flight suit or fatigue uniform when exposed to aviation gas or JP-4 fueled fires behave like so much tinder. They will literally explode into flames when exposed to typical helicopter fires. Not so with the Nomex suit.

The Nomex suit is not a firefighter's suit and it will degrade by melting at temperatures above 900 degrees Fahrenheit. It will, however, protect you during a dash through live flame for a few seconds. That's all you need, and for this purpose it was designed.

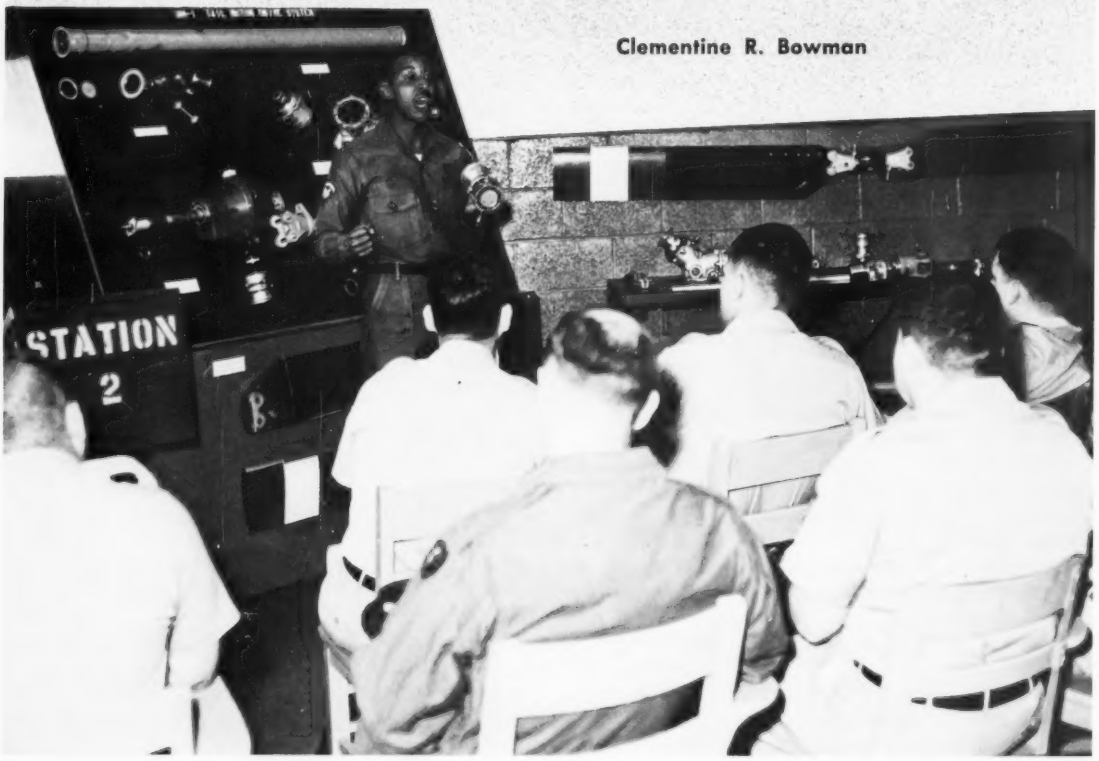
There have been some complaints about scratchiness, skin irritation and lack of ventilation. These are rare and your flight surgeon has some solutions to the problems that do arise. Remember what was said about the dual role design problem? Ask your wife, mother or sweetheart which suit she would rather have you wear.

To the flight surgeon: Physiologic problems and questions about the bioengineering aspects of all life support equipment are of interest to two agencies in particular. You are encouraged to write or call:

- U. S. Army Aeromedical Research Laboratory
  Bioengineering and Evaluation Division
  Box 577
  Ft. Rucker, Alabama 36360
  AUTOVON 558-3001
- U. S. Army Board for Aviation Accident Research
  Life Support Sciences Department
  Ft. Rucker, Alabama 36360
  AUTOVON 558-2091

FORT EUSTIS

This is the second of three articles on Fort Eustis, Va. The first appeared in the September issue of the AVIATION DIGEST and dealt primarily with the courses taught in the Aviation Maintenance Training Department of the Transportation School. Among those items that are discussed in this article are the model shop and those courses taught officers assigned to command or staff positions



Clementine R. Bowman

THE KEY TO ANY successful Army school is its progressive attitude. This is the principle under which the Transportation School at Ft. Eustis, Va., operates. In keeping with this, the Aviation Maintenance Training Department has made several important changes. A realignment of the department incorporating the latest management techniques has been accomplished, a new model shop laboratory has been added and a new course was recently started.

Under the old alignment the department had one division responsible for training problems, management, administration and logistics, and four academic divisions. Now there are two staff elements —one for administrative services and one for training management —and six academic divisions.

In the late 1960s the department was organized so the divisions could meet the demanding needs of the increased student workloads due to the buildup in Southeast Asia. This method allowed maximum cross-utilization of all the department's training

facilities. But students often had to move from building to building to complete one course. Now buildings are set aside for certain courses and a student in the 67N20 UH-1 Helicopter Repair Course remains in the same building for the major part of his training.

Some of the advantages of the realignment are balanced responsibilities and an improved span of control. Formal administration is now conducted at higher levels only. Thus, the instructors are relieved of routine tasks and have more time to devote to the students.

Another result of the change was the establishment of a more personal relationship with the students. It is felt that a student learns better when he is happy.

Students have class counselors who can assist them with academic or personal problems. Many students now have their own coffee break areas and parking lots near their working areas.

The new model shop laboratory combines three primary methods of instruction: demonstration, practical exercise and conference. In this environment the department can create problems in a controlled area. The students are challenged to make solutions to the problems and to try the solutions to see if they work.

The broad concept of the model shop laboratory is to put a future maintenance supervisor in the supervisor's position and let him see and perform the maintenance duties as he would if he were in the field. If an actual maintenance problem can be presented in school, it will not be a problem when the student meets the same situation in the field.

The shop laboratory was put into use in August 1969. The work has been accomplished by using local personnel and supplies wherever possible. Work continues on the laboratory and new training problems and aids are added regularly.

The model shop laboratory is set up similar to a maintenance shop in the field. There are special work areas for airframe, powerplant and flight control repair. Maintenance stands have been built of rough lumber just as a maintenance officer may have to use in the field. The only difference is the addition of bleachers where the students may sit to observe qualified instructors performing functions going on in the shop. There are also mobile shop vans parked beside the building for special types of repair and a small airstrip for deadlined aircraft.

The new 2-week Aviation Commanders Maintenance and Supply Management Course being taught by the department is designed for officers on orders to aviation commands or staff positions.

These officers, captains or above, are instructed in the principles of management as they apply to aviation assets. The course is divided into two main segments of instruction—one on aviation supply management and the other on aviation maintenance management.

They are taught to identify the maintenance and supply management tools available to the commanders which will assist them in using performance indicators—yardsticks which measure the Army aviation supply and maintenance system.

For example, one of the yardsticks will be the condition of equipment and the shop. A student will review statistical data, workloads, backlogs, the type of work being performed and the actual conditions in the workshop. He will learn how the supply system works at higher levels, how inventories are maintained and how new requisitions are processed to maintain the proper stock levels.

He will know how to develop requisitions for his shop based on his needs for repair material and replacement parts such as subassemblies and components. When an engine needs to be changed the supply system will respond to the requirement.

The tools of maintenance management give the commander a check on his shop. Is the shop doing its job? He can give the answers to such questions as this by a check of the total workload, backlog, availability of aircraft, how much downtime the planes have and the proper use of his men.

He learns to develop the backup maintenance needs for a unit in a combat zone, the supply support required and the number of aircraft needed to airlift supplies or evacuate downed aircraft.

In summary, he has gained more than 2 weeks' experience as an aviation maintenance commander before he gets to his new job in the field.

The management techniques discussed here should enhance the effectiveness of the Aviation Maintenance Training Department which is directed by Colonel Garrison J. Boyle III.

The power train shop

Maintenance

...during ground checks

use a little finesse

Installing New O-Rings: When installing new O-rings on bolts such as irreversible valve attachment bolts on UH-1D/H helicopters, use care to avoid damaging the O-rings. You can wrap the threads of the bolt with thin plastic tape, then lubricate the O-ring with hydraulic fluid only, and slide into position on the bolt. Always ensure the O-ring is the correct size. An O-ring will swell when exposed to hydraulic fluid. Therefore, an improper size O-ring or an improperly installed O-ring means **trouble.** (TM 1520-210-20, change 6, section II, paragraphs 6-80, 6-81)

UH-1B, D, H Models Substitute Screws: Bravo Company, 229th Battalion, 1st Cavalry Division (Airmobile) has experienced trouble with access panels (also called door assemblies) on the tail booms of their Hueys. The problem has been the Phillips head screws that hold these panels in place. These screws are made of aluminum alloy and are quite soft. The mechanics who installed these screws with speed wrenches would tighten them and tend to cut the Phillips head slot in the head of the screw. The next time the access panels were removed, valuable time was lost in removing the screws to gain entrance to the interior tail boom area. To prevent this problem, ⅜" hex-headed bolts were ordered of the same diameter and thread per inch. The Federal stock number is 5306-897-5278 and part number is 1-140-244-01. These can be found in the TM 55-1520-210-20P series. This particular bolt is available in both steel and aluminum type construction and a little heavier than the aluminum alloy screws. The hex-head allows for plenty of leverage in extracting this bolt. The steel bolt has a negligible effect on the center of

Matters...

gravity; however, if used, take necessary precautions to protect against dissimilar metal corrosion.

MAINTENANCE TIPS

Use a box wrench when possible. A box wrench is a much safer tool than the open end wrench because when used properly it is less likely to slip.

Shield your (CF3Br) fire extinguisher—the one found in all Army aircraft—from high heat and shock. It can explode.

Use your handling equipment. It protects the aircraft. It is made to pull, push, lift and move parts by putting the stress where it belongs.

Correct torque of cylinder head hold down nuts is important. Each nut must be tightened to the same torque to prevent internal stress of the cylinder head.

The blade of any type of common screwdriver should fill at least 75 percent of the slot.

Any time you have an occasion to spot paint an aircraft, be sure the area is cleaned properly and primer is used. Any grease, oil or dirt not cleaned off will cause the paint to peel.

Ever wonder why it takes so long to get the job done right? Usually it's from using the wrong tech manual or none at all. Use the appropriate tech manual and do the job right the first time. This will save time, equipment, manhours and maybe someone's life.

When operating aircraft with gas turbine engines in conditions of blowing sand or rain and freezing temperatures, ensure that engine inlet covers are securely installed after shutdown. Otherwise, it is possible for sand to collect in the compressor section, causing damage on the next engine start. If covers are not securely installed during freezing rain, wind-blown rain can freeze in the compressor after shutdown. Under this condition ensure that the compressor rotates freely prior to attempting a start (but only after removing those inlet covers).

Do You Know . . . storing the torque wrench with a high torque setting on it weakens the internal spring used for adjustment? This often results in either an overtorque or undertorque condition when the wrench is next used. Always zero the torque setting before putting the wrench back into the toolbox.

A Little Easier, Please: Show a little finesse when checking OH-6A controls at 103 percent N_2. The cyclic should only be moved 1 inch in any direction from the neutral position. Excessive or rapid movement of the cyclic can cause droop stop pounding and damage to the striker plates in the head assembly.

Temperature Going Up: Many T53-L-13 engines have been reported as having high oil temperature problems during the heat of the day. This condition has been relieved by flushing the oil system, changing oil and cleaning filters and strainers. Also, while you're at it check the condition of the oil cooler and oil cooler fan.

HueyCobra Lubrication: Action has been taken and reduced the lubrication interval of the AH-1G swashplate to 25 hours. Lubrication instructions have also been added to the lub charts of the dash 20. To lubricate the swashplate properly, disconnect the drive links and while turning swashplate lub at 30-degree intervals. Don't forget to reconnect those drive links. (This information has been included in change 7, TM 55-1520-221-20, dated 28 Jan 70.)

TV at the Aviation School

New Approaches To Flight Surgeon's Training

Frank Rushton Jr.

THANKS TO television, a new concept is being developed that is proving invaluable to the Department of Aeromedical Education and Training (DAET) at the U. S. Army Aviation School, Ft. Rucker, Ala. Student flight surgeons involved in ophthalmology (study of the eye) and cardiology (study of the heart) courses have been among the first to benefit from application of instructional television.

At DAET, ophthalmology and cardiology are considered to be two of the most important fields for evaluation of pilots and flight trainees. Vision and heart conditions which might be less crucial for civilian or military personnel with nonflying duties assume critical importance where flight personnel are concerned.

Television's unique ability to present enlargement of detail and to make subject patients available on a convenience schedule was first suggested for use at DAET by medical instructors Captains William H. Clark, M.D., USAF MC, and J. Howard Stokes Jr., M.D., USA MC. Working with personnel assigned by the Film/ETV Division, DOI, Captains Clark and Stokes developed approaches to subject material which represent pioneering efforts in medical education at the Aviation School. Results from television tapes produced at the Film/ETV Division studios have been impressive and student reaction has resulted in plans to develop additional tapes.

A medical application of a tape recorder, the electrocardioscanner, was the first subject to be presented on television tape to student flight surgeons. Patients with heart irregularities which are elusive or difficult to diagnose are fitted with a small, slow-speed tape recorder, making possible an 8- to 12-hour record of a patient's heart activities. The resulting tape is then played on the electrocardioscanner which feeds the signal from the tape transport to an oscilloscope tube. Each heart abnormality displays a characteristic waveform on the tube, invaluable to the flight surgeon in making a diagnosis. In this way a 12-hour record may be reviewed in 12 minutes.

Prior to the development of the television tape, "Diagnosing Arrythmias with the Electrocardioscanner," it was extremely difficult to display a patient's heart activity on the small oscilloscope to more than two or three student flight surgeons at a time. The alternative was a static slide used with considerably less instructional effectiveness.

Frank Rushton Jr. is a Department of the Army civilian with 12 years commercial TV production experience. He has been a TV production specialist at the Army Aviation School since 1966

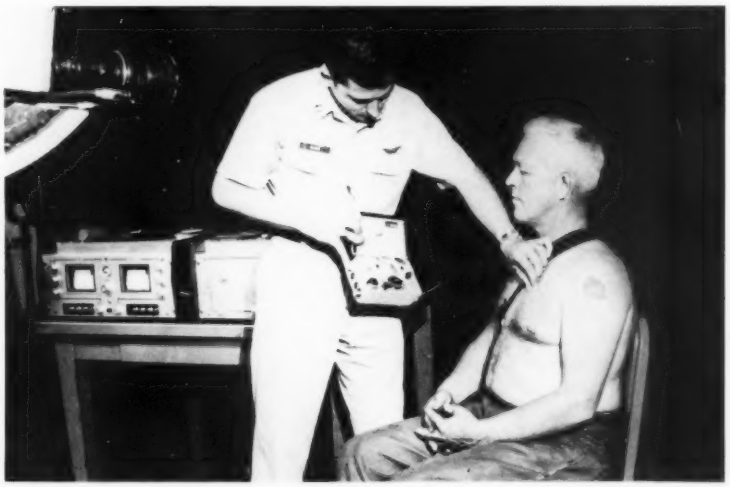
Television has resolved this dilemma in a twofold manner. DAET now has a readily available television presentation demonstrating use of the electrocardioscanner, displaying typical heart abnormality waveforms on the 23-inch classroom receivers. In addition, plans have been made to pull tapes of unusual heart records from the files for TV presentation whenever instructional requirements indicate a need. Information and records acquired now constitute a flexible data bank for future instruction, utilizing television's characteristic enlargement and convenience capabilities.

In eye examinations small eye movements are very significant to the examining flight surgeon. Patients with certain eye abnormalities must be seen by student flight surgeons so they may learn to interpret these movements. Prior to CPT Stokes' incorporation of television in teaching ophthalmology, it was necessary to repeatedly have patients make such movements for the benefit of individual students. Frequently, patients were not available when needed for teaching purposes. With use of the television tape, "Cover Test for Muscle Imbalance," and other presentations to be developed, examples of eye movements essential for diagnosis of eye abnormalities are permanently available once recorded on television tape. They are displayed

on the 23-inch television receiver for simultaneous viewing by all members of the class.

Appropriate explanatory comments by Captains Clark and Stokes were incorporated into the TV presentations on cardiology and ophthalmology subjects. Because these TV tapes were produced locally in the Film/ETV Division studios at Ft. Rucker, DAET physicians were able to continually monitor and coordinate their content during development and production. Film/ETV Division personnel worked with Captains Stokes and Clark in adapting television's special characteristics to aeromedical education and in assuring minimum and rapid response time between conception of the TV presentation and availability of the completed production.

The factors which initially suggested use of instructional television to the Department of Aeromedical Education and Training resulted in its successful use are readily applicable to many areas of military and civilian instruction. Army-operated instructional television units capable of producing and distributing instructional television programs are a useful and flexible educational tool. Response time is markedly more rapid with television than in the case of training film production because of the nature of the electronic medium and because Army ETV personnel are on hand and available locally to work enthusiastically and in a coordinated manner toward achievement of varied instructional goals.



Above: A flight surgeon attaches electrodes from the portable "Electrocardiocorder" to a patient's chest. In 12 hours the electrodes are removed, providing a complete record of heart activity during that period. Below: A television tape for flight surgeons is made to demonstrate the technique for an eye examination. Here a test for muscle imbalance is demonstrated

CPT William H. Clark, M.D., USAF MC, is a graduate of the University of Missouri Medical School. He completed his internship in Internal Medicine at Washington University Medical Center, St. Louis, Mo., and had 1 year in residency at the Washington University Medical Center. CPT Clark currently is serving in the Medical Corps, U. S. Air Force and is assigned to the U. S. Army Aviation School, Ft. Rucker, Ala., as a part of the interservice program to relieve a shortage of physicians. Prior to his Ft. Rucker assignment, CPT Clark attended the Medical Field Service School, Ft. Sam Houston, Tex., and the Flight Surgeon's School, Ft. Rucker. He is an instructor in the aeromedical aspects of cardiology, Department of Aeromedical Education and Training, USAAVNS, Ft. Rucker.

CPT J. Howard Stokes Jr., M.D., USA MC, is a graduate of the Medical College of South Carolina, Charleston. He completed his internship at Lankenau Hospital in Philadelphia, Pa., and partially completed his residency in ophthalmology at Wills Eye Hospital, Philadelphia. CPT Stokes is an instructor in the aeromedical aspects of ophthalmology, Department of Aeromedical Education and Training, USAAVNS, Ft. Rucker.

DON'T SPILL

THERE WAS A saying among Chicago's brewery drivers that if you kept your hands on the wheel and your eyes on the road, you wouldn't spill any beer. Army instrument helicopter pilots may draw a useful parallel here in the need for a steady hand and a keen eye.

Consider first the human hand. The relaxed hand should feel somewhat like a mother-in-law's handshake. This state of relaxation is desirable if we are to avoid wasteful overcontrolling of the cyclic pitch control while flying on instruments. A very important result of relaxing the hand is that it now becomes a natural extension of the arm and its position is determined by the position of the arm. It follows that the position of the arm is a vital consideration in control of the aircraft. Precise control of an extended arm is the impossible dream of pistol marksmen and, at best, requires constant attention and concentration. The solution is, of course, to place the arm in a comfortable, *relaxed* position on the leg.

The next step in this little anatomical game is to determine what separates smooth, effortless instrument flights from catastrophies ranging from overcontrolled corrections to self-induced errors. If while maintaining the aircraft at cruise airspeed in straight and level flight we divert our attention for a moment (say to glance at a chart or radio), the aircraft should continue to fly with no perceptible change in attitude. If the attitude does change, our hand was not in the proper position because when we forgot about it, it relaxed and moved the cyclic.

It is not enough to move the hand in the direction of the needed correction. It is not even enough to move the arm if all we do is move the bone within the skin and sleeve. The arm should be repositioned by physically sliding the arm and sleeve material over the leg in the direction of the needed correction. After finding this relaxed arm-hand-cyclic position, you should be able to close your eyes for 4 or 5 seconds (don't do this in the clouds) without changing the attitude of the aircraft. Moreover, any instrument maneuver may now be performed without strain and with very little mental effort. Enough cyclic friction should be applied to avoid turbulence feedback, but not so much as to require a tense hand for control pressures. Now that we are no longer fighting our own control inputs, we can begin to fly helicopter instruments.

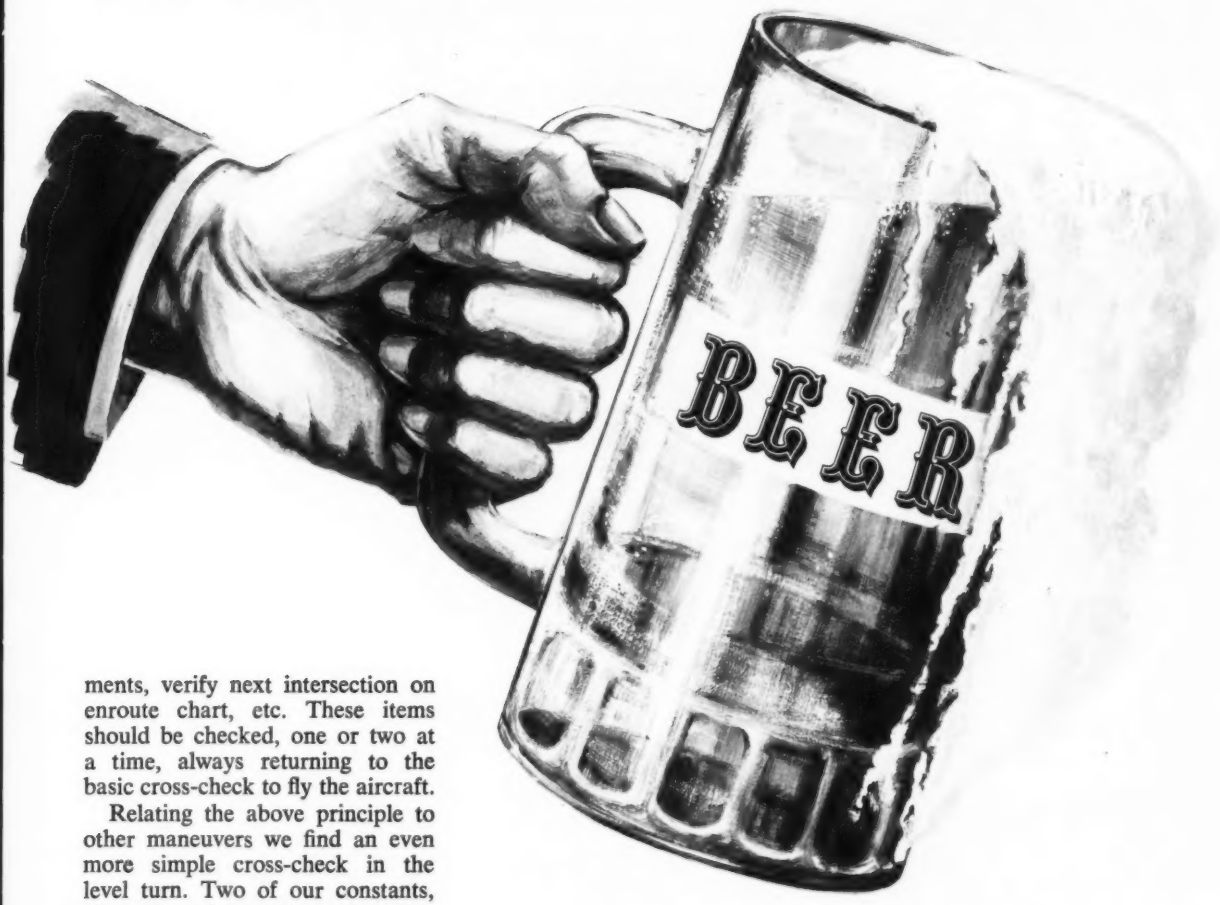
Imagine a man driving a loaded beer truck through the outskirts of Chicago at 50 miles per hour. Beside him is a map of the local "speak-easies." Out of every 5-second interval he looks at the road for 2 seconds and at his map for 3 seconds. This man is throwing himself at the mercy of the laws of nature and will probably die of drowning in a ditch full of beer.

Ridiculous, you say? You would never do that? But would you waste precious seconds or fractions of seconds away from the instruments that are of *primary* importance in guiding those several tons of metal and fuel and your body through the clouds? There are better things to drown in than a ditch full of JP-4.

Consider a helicopter in straight and level flight. We can describe the flight of this aircraft in terms of three constants: altitude, heading and airspeed. These quantities are our "road." We may say that if we maintain our altitude and set in cruise power our airspeed will take care of itself, within limits. So if we relegate airspeed as an item to be checked at less frequent intervals, that leaves two constants: altitude and heading. Now we may develop a rapid cross-check of three instruments: altimeter, radio magnetic indicator (RMI) and attitude indicator. We check the altimeter and RMI for errors in altitude and heading and check the attitude indicator to measure the corrections that we have applied with cyclic pressure. This cross-check of these three instruments should be rapid enough (once or twice a second) to detect and correct errors while they are still very small, i. e.; 10 feet, 3 degrees. Now, every fourth or fifth cross-check we have a list of items that require our attention: check magnetic compass to verify RMI indication, check trim, check airspeed for high or low trend, check engine instru-

THE

CW3 Charles R. Sturtevant



ments, verify next intersection on enroute chart, etc. These items should be checked, one or two at a time, always returning to the basic cross-check to fly the aircraft.

Relating the above principle to other maneuvers we find an even more simple cross-check in the level turn. Two of our constants, airspeed and altitude, remain the same. Heading, however, is replaced by rate of turn. After we entered the turn we saw what angle of bank was required to maintain the desired rate of turn, so let's change the third constant to angle of bank. We may now begin a rapid cross-check of only two instruments, the attitude indicator and the altimeter. Corrections for altitude are again measured on the attitude indicator and angle of bank is maintained solely by reference to the attitude indicator. As before, for level flight cruise power controls our airspeed. The headings as indicated by the RMI now goes to the top of the list of items to be checked every few seconds and, due to the brevity of most turns, is checked more often than the other items.

The constants to be maintained in a straight descent are airspeed, heading and rate of descent. Airspeed, which we have thus far tried to avoid chasing, becomes more important in a climb or descent or, for that matter, any time power is changed. Our cross-check includes the attitude indicator, RMI, airspeed indicator and vertical velocity indicator. Rate of descent should not be corrected with power until airspeed has been checked. Now the altimeter goes to the top of the list of "additional duties."

A climbing turn is, of course, a climb and a turn. A cross-check

for this maneuver is a combination of the two.

An acceleration - deceleration, that maneuver which everyone seems to complicate, is nothing more than straight and level flight in which airspeed is changed by smoothly changing power and trimming the aircraft.

Up to this point nothing has been said about the order in which the instruments are cross-checked, it can't make any difference unless your eyeballs twirl clockwise easier than counterclockwise or vice versa. We must now consider emergency panel work and there is a required order to the cross-check. The magnetic compass must only be read after checking the turn-needle.

For emergency-panel straight and level flight our rapid cross-check includes turn-needle, magnetic compass and altimeter. Again airspeed is set by cruise power. This is where our relaxed arm-hand-cyclic position pays off with a minimum of small, smooth corrections.

The cross-check for emergency panel level turns simplifies to turn-needle and altimeter. Of course the magnetic compass goes to the top of the list of things that require our attention every few seconds and as the maneuver progresses it is incorporated in the cross-check.

For a straight descent the cross-check becomes turn-needle, magnetic compass, airspeed and vertical velocity indicator.

Without going through an explanation of compass errors (refer to most any text on instrument flying), let's consider some of the effects dip-error will have on our attempts to fly emergency panel. With the aircraft on a heading of north, let's say our pilot tries to read the compass when the turn-needle is slightly displaced to the right. When the aircraft was inadvertently banked to the right, the compass started to swing around to indicate 355-350-345 degrees. In other words the compass initially swings to indicate a turn in the opposite direction. The pilot sees compass headings that indicate northwest and banks the aircraft further right to correct to north. By the time he gets the turn-needle centered, his heading is 060 degrees and the aircraft is in a screaming dive because he hadn't been checking his altitude. *Don't*

read the magnetic compass until the turn-needle is centered and has been for a moment.

The opposite effect is displayed on southerly headings and the compass indicates a turn in the direction of bank. However, the compass will indicate a healthy turn when in fact the aircraft heading may only have changed a few degrees.

In properly executing a *gyro* turn we know that we must lead the desired heading in beginning the rollout. The rule of thumb is half the angle of bank. Now many students ask if they should also begin the rollout early, by half the angle of bank, for a compass turn. The following explanation is not given to be included in any course of instruction but provides food for thought for those who must have an exact answer. An aircraft that is turning at standard rate must be leveled gradually to stop on a heading and half the angle of bank is a good rule. The problem is how to read this angle on the compass.

Let's take the example of an aircraft in a left turn from 180 degrees to 090 degrees. As the aircraft turns 30 degrees—from 150 degrees past 120 degrees—the compass card turns 20 degrees (i.e., from 130 degrees past 110 degrees). In fact for every 30 degrees of aircraft heading change from south to north, the compass card turns 20 degrees. Now for every 30 degrees of aircraft heading change from north toward south, the compass card turns 40 degrees. Hence we can see that the ratio of compass card rate to aircraft rate when turning toward north is 20 degrees to 30 degrees or 2/3. When turning toward south it's 40 degrees to 30 degrees or 4/3. So if the angle of bank is 12 degrees, then half the angle of bank is 6 degrees, and when turning toward north rollout is begun 2/3 of 6 degrees or 4 degrees early. When turning toward south, rollout is begun 4/3 of 6 degrees or 8 degrees early. When a turn is made through north, the compass is moving rapidly and rollout must be started sooner.

Instrument flying is a demanding skill requiring good use of one's time and good management of cockpit duties. With a smooth control touch, an efficient cross-check and sufficient practice it becomes as natural as driving a car —or beer truck.

Woes Of An Old Veteran

Wesley M. Veazey
Lycoming Representative

STEP UP men and listen to my tale of woe. For you new guys my parents call me T53, but all my friends refer to me as Toughie, a little nickname I've picked up during 7 years of service in the Republic of Vietnam.

Although I'm a lightweight, less than 600 pounds in full combat dress, I'm willing, capable, reliable and tough enough for anything I was designed for. I've even been known to get my crew back home with a couple of .50 caliber holes in my side. But would you believe it's this same tough reputation that causes over 90 percent of my troubles.

Some of the best men this country ever produced are my keepers and users. But, because I'm usually always ready to go and very seldom complain they sometimes bypass me on the preflight or overlook the bleeding out of my lifeblood, which they call 7808 or 23699.

My best pal, the crew chief, has even been known to leave half his toolbox in my mouth. I'm a little like the old goat in this respect—I'll eat *anything*. But oh boy, what indigestion!

Another little item that has killed some of my brothers (along with the crew) is overlooking those funny little prongs on my lifelines. If they aren't all the way out the line is not on and we are in trouble.

I have many ways of communicating with the crew. I can tell them when my diet of fuel and air isn't in the proper ratio, or when they are demanding more out of me than I can produce. Some smart guy even put a go no-go card in the cockpit to tell the crew if I can get them out of a tight spot, but does everyone know how to use it? Do you? Was it changed when I replaced my brother last week? Was it corrected when the maintenance officer pulled the last trim to torque check?

Have you ever flown into a safe landing zone and thought old Charlie was shooting .30 caliber at you? That just may be me trying to tell you something. Like all good soldiers I enjoy a little drink now and then, but since I can't drink scotch I prefer a good shot of P-D-680 followed with a water chaser about every 50 hours. It sure does wonders for my disposition.

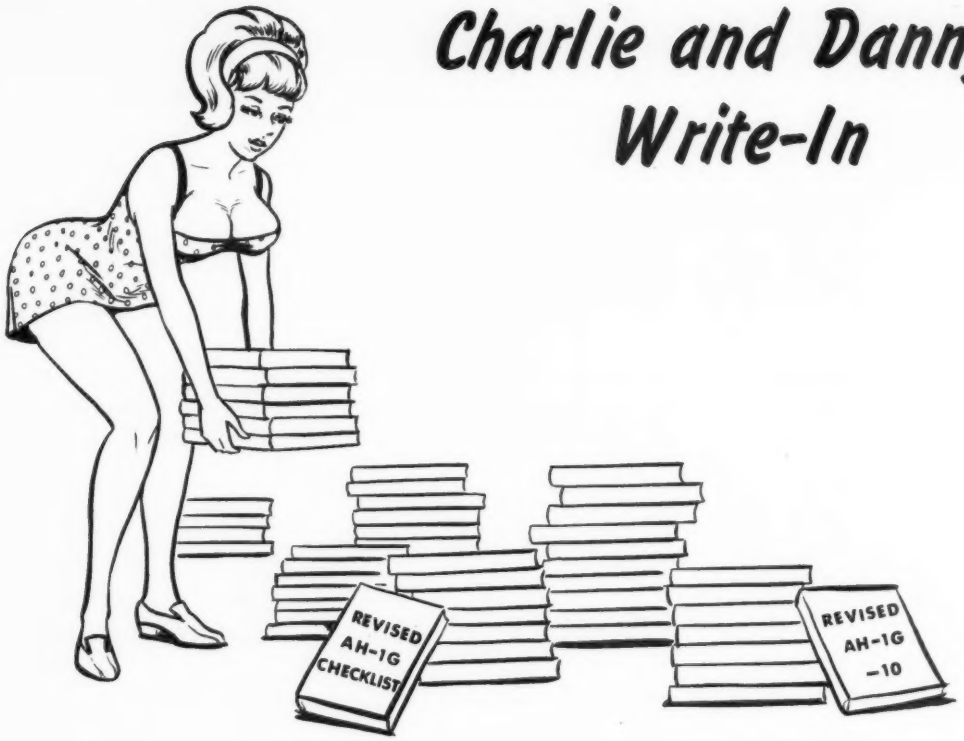
And, of course, like the rest of the troops I have to have a medical checkup at regular intervals to keep in good fighting form. But in this area I must rely on my crew. The hour interval is no sweat because everyone wants his air medal, but have you ever seen the guy who thinks it may make him look bad to write up a little mistake? Or who says, "Oh well, so the battery only had 12 volts; I only went up to 700 EGT, I got the darn thing started and who is to know anyway?" Well, my friend, your old drinking buddy may know tomorrow when he fails to return from that milk run. If I should give you any kind of indication I'm not in the best of health, *please* write me up so the wrench turners can get me smiling again.

Some very nice people have taken a lot of time and money to write books about my care and feeding. They are called operating and maintenance manuals. Now, if these are read, understood and followed I should be able to complete my tour and get back home. But, like everything else there's always the 10 percent who don't get the word and I end up going home early, or worse not getting back at all. This costs the taxpayers a few extra dollars and it doesn't make the commanding officer very happy to know he isn't getting the most out of his equipment.

Another excellent source of information is available through a pretty nice group of guys you sometimes see holding up one end of the bar in the officers' club. These are the friendly technical representatives sent out by my parents to help you keep me in tiptop condition. Remember, these men work with you, live with you and fly with you. They are available 24 hours a day to help you help me and they have a direct line to the people who made me in the first place. So, use them and make us both happy.

I don't mind getting shot at by Charlie but please don't help him!

Charlie and Danny's Write-In

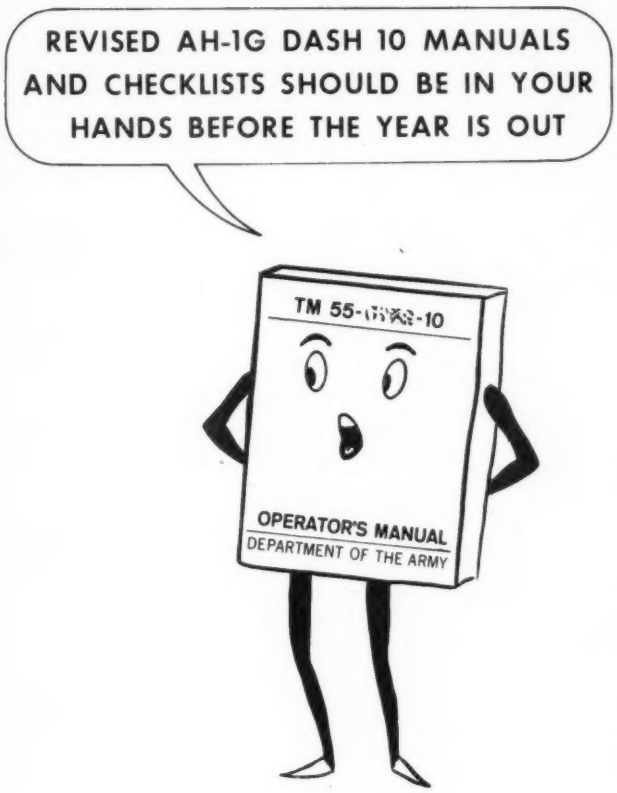


THE ITEM in the "Charlie and Danny's Write-In" section of the September issue of the DIGEST regarding the deletion of the go no-go chart from the AH-1G and UH-1H operator's manuals is in error. After this item was submitted to the DIGEST, a conference was held to discuss revisions to the AH-1G manual and it was determined that the procedure should remain in both publications. When this change is printed and distributed, it will contain go no-go procedures. Aviators operating the AH-1G and UH-1H aircraft should exercise extreme caution when applying the procedure and monitor the torquemeter since the 50 psi torque limitation can easily be exceeded when applying maximum N_1 in the -13 engine.

Dear Charlie: The latest revisions to the CH-47 checklists require that communications and navigation radios be turned on after starting the APU. I was wondering why the changes were made since it seems that the radios would wear out faster due to the interruption of electrical power on engine starting.

SP6 V. T. B.

Charlie's answer: The step for turning the communications and navigation radios on was moved from *after starting the engines to after starting the APU* for several good reasons. First, it makes pilot/tower communications possible prior to engine starting and blade rotation, thus allowing the pilot early warning from the tower of engine fire on start, of hazardous ground vehicle or personnel movements, or of rotor wash from other helicopters. In addition, in a tactical environment it allows the crew to stand by on the radios for mission information


REVISED AH-1G DASH 10 MANUALS AND CHECKLISTS SHOULD BE IN YOUR HANDS BEFORE THE YEAR IS OUT
TM 55-[illegible]-10
OPERATOR'S MANUAL
DEPARTMENT OF THE ARMY

without unnecessarily cranking the engines. No factual data has been submitted which would indicate any significant extra wear on radio components. We would appreciate any feedback on this checklist item.

Dear Charlie and Danny: In the June "Write-In" there was an item regarding the air speed and flap setting used on a U-1A for a paradrop. This information for all Army aircraft is contained in chapter 19, FM 1-105, 20 June 1969, w/Ch. 1. There is a wealth of other useful information in this FM, but I don't think all aviators are aware of it. Recommend you mention it in your next column.

MAJ K. E. M.

Charlie and Danny's answer: Consider it mentioned and thanks for calling this reference to our attention.

Dear Danny: I need clarification on a NOTE in the OH-6A dash 10 (Change 4, dated 24 April 1970; TM 55-1520-214-10). On page 3-5, paragraph 3-21 "Starting Engine" a NOTE states: "In case of a false start, hot start or start not completed in a total time of 45 seconds at ambient air temperature above 10°C. (50°F.), return throttle to FUEL CUTOFF position." However, it also states in the same NOTE that "Ignition time limits are: 2 minutes ON, 3 minutes OFF; 2 minutes ON, 23 minutes OFF." What's the word? I was taught during the transition course that if the starter was motored longer than 45 seconds under normal operating conditions that there was a strong probability of burning out the starter motor.

CPT B. C. T.

Danny's answer: The starter time limit is 45 seconds at ambient air temperature above 10°C. The ignition time limits which are published in Change 4 are also correct; however, they are for the ignition system only. This NOTE has caused confusion and has been modified for Change 5 which is to be published soon. The ignition time limits will be omitted from the operator's manual but will remain in the dash 20.

Dear Danny: When is the next change coming out on TM 55-1520-221-10 and CL (AH-1G)? Seems there are quite a few errors in our present manuals. By the way, what is the latest change in effect for the dash 10?

WO1 S. I. G.

Danny's answer: Your letter arrived at a most timely moment. We have just completed a conference at the factory and have completely revised the dash 10 manual and CL. This revised manual should be in your hands before the end of the year. The latest effective change to the dash 10 is Change 8, dated 23 December 1969. Incidentally, have you listed all the errors which you found on a DA Form 2028 and sent the form to USAAVSCOM?

Before all you guys start writing in I had better bring you up-to-date on the new performance data charts. As of this date I do not have any more information reference the publication of the charts for the UH-1/H. Additional information has been obtained and is being incorporated in the charts. As soon as I receive any information, I'll pass it on. Sorry about the delay, fellas—some things take a bit longer than others.

DANNY

P.S. You Cobra pilots can expect a format change on your preformance charts, also. I'm not going to predict a date but it should be in the near future.

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Systems engineering may be involved but it is not as difficult as some would make it appear

...UST ...HAT ...YSTEMS ...NGINEERING?

Major Richard L. Irons

FOR YEARS the Army has been preparing various programs of instruction (POI) for all military occupational specialty (MOS) producing courses. These programs outline the subjects that are taught, the number of hours devoted to each subject and the scope of each subject. In the past there was no standardized method used; the procedures followed were left up to those developing each POI. In other words, a person might have been assigned to write a POI for a 10-week course designed to train mechanics. Where did he start? What procedure did he use?

Without standardized guidance one first had to try to decide what a mechanic should learn, and by juggling the hours to be spent on each subject he came up with a 10-week course which hopefully would train a mechanic. Could this mechanic perform adequately the first day he was put on the job? Perhaps, but the answer in too many instances was *no*. As the U. S. Continental Army Command (CONARC) became aware of the problem, steps were taken to develop a standardized method which everyone could follow when designing a course of instruction.

This is what systems engineering is—a standardized step-by-step procedure that has been established for developing realistic job related courses. The procedures followed are outlined in detail in CONARC Regulation 350-100-1. These procedures can be used to design new or redesign existing courses of instruction.

How does this approach to designing courses affect us and what does it mean? First, because this is a meticulous process, it is estimated that it will take 5 years (beginning in April 1968) to redesign the existing instructional courses. Second, many duplications which existed in nonsystems engineered courses will be eliminated and nonessential information which may have crept into courses over the years also will be eliminated. Finally, since this method is very job oriented, it ensures that training given in systems engineered courses is training that course graduates need to perform adequately when they arrive on the job. This means that units in the field will receive trained personnel who can effectively perform their jobs with a minimum amount of on-the-job orientation. More realistically, they become a functioning part of an organization in much less time. Far fewer weeks or months will be spent on the job preparing them to assume full responsibility of performing their mission. This idea of making the training as job oriented (or realistic) as possible is emphasized in each of the design phases.

Let's briefly look at what is involved in each of these

phases or steps. Initially, much attention is given to analyzing exactly what the man (the graduate from whatever course is being designed) is required to do in the field. This includes considering what tools he will be required to work with, what equipment he must use, where he might be assigned (units as well as locations), how much supervision of the man is anticipated and several other items including major job requirements. Notice that this analysis again is job oriented and quite detailed. There are many sources of information available to assist in this analysis and these are listed in CONARC Regulation 350-100-1. The initial analysis is complete after preparation of a detailed list identifying every item or task a man in the MOS relating to the course is expected to accomplish in the field. As might be expected, the list can become quite lengthy, but this completes the first step in the design process.

Before we progress any further we should look at what qualifications people who design courses using this method should possess. Since a thorough analysis of the job is required, it logically follows that people with considerable experience in the MOS for which a course is being designed should be assigned the mission. The contributions they make can be of immeasurable value to the quality of the course. Conversely, the damage that inexperienced people can induce is time consuming to identify and costly to correct. Errors can be minimized only through careful selection of those to whom this extremely important mission is given.

In addition to extensive field experience these personnel also should have instructional experience. This will allow them to incorporate effective teaching methods that clearly reflect the requirements needed on the job. These are only two desirable qualifications; there are, of course, many other considerations in selecting personnel.

There also is much assistance which can be given to personnel selected. For example, a group of well-qualified mechanics, maintenance supervisors and technicians who all have had experience instructing might be selected to design the mechanics course. It would be a mistake to think that they could read the regulations and go to work without additional help. Educational specialists should be provided to explain each design step that is necessary and to render advice on technical matters such as proper selection of training materials. So we see that the selection of personnel to design courses and the assistance given them is extremely important under the systems engineering concept. Now let's take a look at the second step in the design process.

Once the man's job has been thoroughly studied and we have identified each task which a man with this MOS might be expected to accomplish on the job, we take another look at the list we prepared and decide precisely on which of these tasks we will train the individual. Why don't we train him on all of those tasks he will be expected to accomplish? Well, we could find that we have indicated the mechanic must know how to wash an aircraft, and indeed he might. However, after studying this we might decide that it would be easier and more economical to teach the man this job after he gets in the field. Also, its exclusion from the course would not seriously interfere with his being able to perform effectively immediately upon assignment to a unit in the field.

We might further find that some of the tasks we listed are performed only by a small percentage of people with this MOS and devoting time to teaching these tasks would be wasteful. Still other tasks may be categorized as either prerequisite to the course under study or Army subject schedule material. After carefully examining the tasks on our list, we select those that will result in the most effective training program. This list of tasks would then be those the man is required to do in the field and on which he should be trained. It represents the backbone of our course and if we have done our homework correctly and if our analysis has been right, the training that this man receives will enable him to perform properly upon graduation.

After the tasks to be taught have been selected, each one is carefully analyzed to determine under what conditions the task is performed in the field, what standards must be met by the experienced job holder and what knowledge, skills and attitudes must be possessed in order to perform the task effectively. This information will assist in the design of a realistic job related course. Then each task is changed into an objective and the exact sequence to be followed in teaching them is established. This means that after the sequencing of each task is accomplished

- the necessary teaching points to accomplish the training objective are determined
- the references to be used in developing the lesson plan are listed
- the most appropriate method of instruction is identified (since this whole procedure is job

oriented, much more "hands on" training or practical exercise type training will evolve)

• the most effective and appropriate training aids are selected

• the necessary training equipment and material for the ideal course are listed

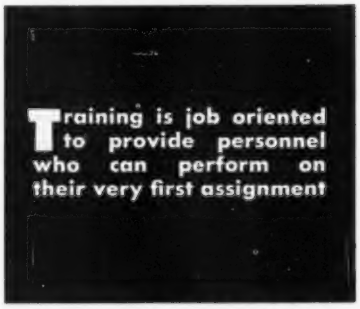
• the required training facilities are identified

• the time required to train the student on each task is estimated.

All this information is established for each task on which the student will be trained. Indeed, this is an impressive amount of material which is derived for each task, but once this step is completed the entire program is well under way.

It was stated above that while the tasks selected for training were being analyzed to see how they should be taught, the time required to teach each task was estimated. Note the difference in this approach as opposed to the approach stated in the beginning of this article where you were given the mission of designing a course which would train mechanics in 10 weeks. In the systems engineering approach no time was stated. It was only after a careful analysis of each task was completed, and the best method of presenting each established, that an estimated time was listed. This does not include time required for examination purposes, introduction and conclusions to the lesson and break or transportation time. These times are determined when the lesson plans and course schedules are being prepared. You might well expect that if duplications and nonessential information were dropped from a course (due to the careful analysis involved) that some savings in time might be realized. This is a possibility and hopefully there would be a savings in time; however, it must be realized that because of the depth of research and study that designing a course involves, just the opposite might occur. This means that because of the careful analysis it might be determined that the man in the field needs to be taught some material on a particular subject which was not covered in a previous POI. Or, this analysis might reveal that instead of spending 2 hours on a certain block of instruction the student actually needs 4, 6 or even 8 hours on that subject to enable him to perform his job properly after graduation. It is, therefore, possible that the length of the redesigned course will be greater than the original course.

The bulk of the course has now been systems engineered or, if you prefer, designed. What happens to this information? It is provided to



those personnel responsible for the development of lesson materials and testing materials. Since the information provided includes training objectives, a skeletal lesson outline and points in the program where tests should be administered, the tasks of writing lesson plans and tests are somewhat simplified for the instructor. More detailed information is available than was available under the old system. Now the POI and the master course schedule can be prepared and forwarded to CONARC for approval.

After the CONARC approved course is conducted, the final step of the systems engineering process, quality control of training will indicate the effectiveness of the designed course of instruction. The quality control step is never really finished because the evaluation of courses is a continual process. Feedback information from students, instructors, examinations, evaluators and all other internal (within a training base) sources of information are combined with all external (outside a training base) sources such as questionnaires, interviews and liaison visits with industry. The course is then evaluated and all appropriate changes are made.

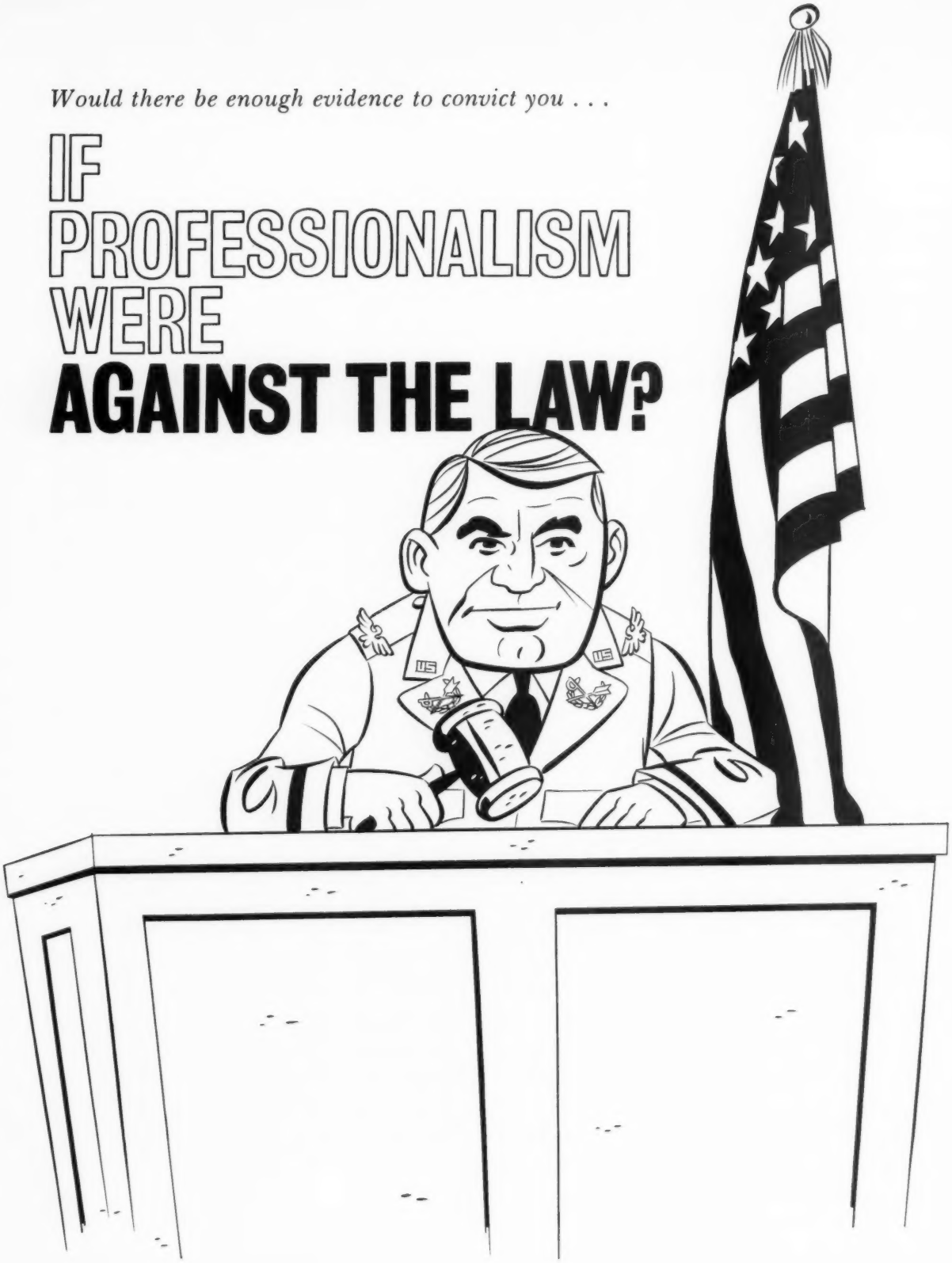
The proof is definitely in the pudding and to establish the validity, or effectiveness, of our efforts, one essential external source of feedback must not be overlooked. We must visit the field and discuss with commanders whether or not the graduates can perform adequately with minimum on-the-job training immediately upon assignment.

Systems engineering is not complicated although the steps used are detailed and the development of a course using these steps amounts to a tedious process. But the value of the efforts of those responsible for designing the required courses at the various training bases throughout the Army will be felt by all of us for a long time to come.

The systems engineering procedures for designing courses of instruction has been established for the first time in CONARC Regulation 350-100-1. Many of the items outlined have been done in one form or another before, but this regulation has established a set of standardized procedures which can be used by all Army personnel to design courses of instruction which will provide graduates who are able to perform more effectively upon initial assignment. This step obviously will increase the overall effectiveness of our combat potential if each one of us understands and properly uses this improved method of designing courses of instruction.

Would there be enough evidence to convict you . . .

IF PROFESSIONALISM WERE **AGAINST THE LAW?**



Ted Kontos

MAJOR JONOTHAN Upright wore a determined expression as he spoke to the court-martial board. ". . . When a farmer was asked why he was plowing with his herd bull when his barn was filled with modern farm machinery, he wiped the sweat from his brow and spat. 'I figured it was about time to teach this hardheaded blankety-blank that there's a darn sight more to farming than just producing quality beef.'

"Gentlemen," the major continued, "there's a lot more to flying than just getting a plane into the air and back on the ground. Flying requires the combined efforts of a variety of talents and skills—operations personnel, meteorologists, control tower operators, maintenance and supply personnel, airfield maintenance crews and, of course, pilots—just to name a few. Yet, of all the individuals involved, only the defendants," he pointed a long slender finger at Major William Fairman and Sergeant Donald Trotter, "have been charged with displaying professionalism in their respective duty assignments. Furthermore, this charge stems solely from the fact that their flight in a UH-1 was successfully terminated. If these defendants are guilty, so are all the supporting personnel who helped make their flight successful. If, on the other hand, the supporting individuals are innocent, so are the defendants."

The murmuring which began among the spectators was cut short by the powerful voice of the trial counsel who sprang to his feet and shouted, "I object! What the defense counsel has just said may sound plausible, but it has no merit whatsoever! The part supporting personnel played in the successful flight was, at best, negligible. Just because they performed their respective duties satisfactorily in dealing with one particular flight does not necessarily mean they displayed professionalism in the discharge of their duties during their entire duty day!"

"Objection sustained," the military judge intoned.

Beaming with pride at having won another point, Captain Kalastung strode to the defendants' table, then turned to face the members of the board. "Let me reiterate the facts. Major Fairman was scheduled to fly a UH-1 to this station. Sergeant Trotter, his crew chief, was to accompany him. You have already heard testimony that Sergeant Trotter did, in fact, perform every function required of him as crew chief. This testimony was substantiated by his admission that, to the best of his knowledge and ability, he did perform his duties as taught, and in accordance with his unit's SOP and other pertinent directives.

"Prior to the flight, Sergeant Trotter checked the aircraft forms, performed a daily inspection, readied the aircraft for flight, stored the baggage, made appropriate entries and assisted the pilot. He was properly outfitted for flight, including helmet, gloves, flight suit and boots. He used the restraining equipment provided in the aircraft. After landing at this station, he immediately requested fuel and supervised servicing. He then completed a postflight inspection and ensured the aircraft was properly secured. He even cleaned the aircraft and policed the surrounding area. From testimony you have heard, it's obvious that Sergeant Trotter not only performed his required duties, but far exceeded them. . . ."

The sergeant listened intently at the words of the prosecutor and heaved a troubled sigh. Unfortunately, the words were all true. He could think of nothing to exonerate him. As a matter of fact, he would have been more than willing to have entered a guilty plea and thrown himself at the mercy of the court. It was only at the insistence of his counsel that he had not done so. Major Fairman would now take the stand and there was no doubt in the sergeant's mind that the major was as guilty as he was. He had known and flown with him long enough to know he was a professional. The trial counsel's voice broke into his thoughts. ". . . I would now like to call Major Fairman to the stand."

"Your Honor," Major Upright rose, "before we continue, I'd like to make a personal request." With the judge's permission, he walked past the board members to his right and the court stenographer, approached the bench and leaned to speak to the judge in a low voice. The judge nodded and Major Upright turned and motioned to a young corporal seated among the spectators. The corporal rose and Major Upright whispered orders into his ear. He returned to his seat as the corporal left the room.

Major Fairman was visibly disturbed as he answered question after question from the trial counsel. "Major Fairman," the counsel continued, "you have stated that after checking the weather and completing all routine preparations, you filed your

flight plan. Please tell the court what you did next."

"It was still early for the flight, so I went to the cafeteria in the operations building and had breakfast. After eating, I went to the aircraft. Sergeant Trotter had performed a daily inspection and had the aircraft ready for flight. I checked the forms and made a walk-around inspection."

"Preflight?"

"Yes."

"What did you do then?"

"By this time, flight line personnel had arrived and we were ready to fire up."

"Start the engine?"

"Yes. The sergeant and I climbed in, started the engine, went through the checklist and, with permission from the tower, hovered out to the runway and

made our takeoff on schedule."

"In other words, you followed all procedures as required?"

"That's right."

"You didn't violate any regulations?"

"Not to my knowledge."

"Tell the court how you were dressed."

"I wore a flight suit, boots, gloves and flight helmet."

"Were you properly restrained in your seat?"

"I was."

"Did you deviate from your planned route at any time during your flight?"

"No."

"Then it's true that you did, in fact, perform your assigned duties in a highly skilled and professional manner, did you not?"

Major Upright shot to his feet. "I object! Your Honor, the prosecutor is attempting to put words in the defendant's mouth that will tend to incriminate him!"

"Objection overruled," the judge drawled. "The question follows the previous line of questioning and is in order."

Captain Kalastung wasted no time. "Answer the question, Major Fairman. Isn't it true that you performed all of your tasks in an exemplary manner?"

Major Fairman hesitated, then stuttered, "I-I guess so."

"No guesses, Major. Yes or no?"

"Yes! Yes!"

Before he could add anything to his admission of guilt, Captain Kalastung cut him short, "That will be all. Your witness, Major."

Major Upright rose and turned toward the judge. "Before I begin questioning the defendant, I would like to ask that this court be recessed to allow time for my initial request to be completed."

The judge glanced at his watch. "Request granted. This court will recess until 2 o'clock this afternoon." He came down with his uplifted gavel. "That should give you ample time, Major. Meanwhile, I'm placing the defendants in your custody."

"Thank you, sir," Major Upright replied. As the spectators began to file out of the room, Major Upright led Major Fairman and Sergeant Trotter into an anteroom, dropped his briefcase on a table, pulled out a chair and sat down. "All we can do now is wait," he told them.

Major Fairman lit a cigarette and stepped in front of a window overlooking a courtyard nestled within the three sides of the U-shaped building. Except for a lieutenant sitting on a concrete bench, it was deserted. The major drew on his cigarette and slowly exhaled a stream of smoke, his eyes glued to the young officer. It hadn't been too many years since he'd been a lieutenant. He remembered the big ideas, confidence and touch of cockiness he'd had when his future lay ahead of him. Where was that future now? After years of hard study, practice and experience, he could see it all going down the drain. He flipped the ashes from his cigarette and turned to the sergeant. "Well, it looks like the finish of a couple of careers."

The sergeant, sitting in a stuffed leather chair, was oblivious to the major's words. His eyes were glued to Major Upright. "There's just one thing I can't understand. Nobody is perfect. Yet, I swear I couldn't think of anything I did wrong, or anything I didn't do."

"It's hard to break established habits—good or bad," Major Upright said, as he shoved papers back into his briefcase. "I've just taken another look at your records. Can't find anything I can use in court. It appears you've both been extremely thorough and efficient throughout your careers."

"I'd never have believed this could happen to me," Major Fairman remarked.

"It's a crazy law!" Sergeant Trotter exclaimed.

"Unfortunately," Major Upright replied, "it isn't a matter of testing the validity of the law that concerns us right now. Our job is to prove you innocent."

The sergeant quickly responded, "I've been curious about that. How do you plan to do it?"

"Admittedly," the major answered, "things don't look too bright right now, but I believe they'll improve when the corporal gets back." Before he could elaborate, there was a knock on the door. Major Upright opened it and a boy entered, carrying a sack and box. "A Captain Kalastung told me to deliver this to you," he said.

"Well, Claude does have a soft spot in his heart, after all," Major Upright said, "and we can use some nourishment." He took the parcels from the delivery boy, pressed some change into his hand and closed the door. Opening the sack, he passed out hamburgers and French fries. From the box he drew three large cups filled with ice and coke.

"Smells delicious," Major Fairman observed. "I wish I were hungry."

"Me too," agreed Sergeant Trotter. It looks better than a lot of the meals I have."

As they began to eat, Major Upright reached in his pocket, pulled out a pen and scribbled on the paper sack. He tore off the portion he'd written on and stuffed it into his pocket. They ate in silence.

Major Upright drained his cup, stood, looked at his watch and began pacing. It would soon be time

to return to the courtroom. Where could they be, he wondered. Another knock on the door answered his thought. He strode to the door and flung it open, revealing the young corporal.

"They're here, sir."

Major Upright followed the corporal to the courtroom entrance where three men waited. With them was a wheeled stand covered with canvas.

"Good! I see you were able to find one. I'm Major Upright," he introduced himself. "Bring it in, please." He opened the courtroom door and motioned the sergeant in charge to have the men wheel the covered object inside. "Were you and your crew able to find anything?"

The sergeant produced an envelope. "It's all in here, sir."

"Good. Hold on to it."

A crowd of spectators began to file into the courtroom. This was the first case to be tried involving the recently enacted law making professionalism a crime. Most of the spectators were aviation personnel with personal interests in the outcome. In a short while the court was once again in session. Major Fairman was seated in the witness chair.

Major Upright said, "Major, you stated previously that you could not recall having violated any regulations or directives during the flight in question. You said you could not think of anything you did which might be interpreted as a nonprofessional action. Further, you said you could not recall having omitted anything that should have been done. In other words, you have virtually admitted your guilt. Is this correct?"

Major Fairman hesitated momentarily, then answered, "Yes, that's correct."

"Major Fairman," the defense counsel continued, "I must remind you that your Army career can be drastically affected by the outcome of this trial. Are you fully aware of this?"

"Yes, I am."

"Can you, then, in your own defense, at this time, think of anything you may have done or not done which might tend to exonerate you?"

Major Fairman frowned and his hands gripped the chair arms. He thought desperately, then shook his head. "I'm sorry, but I can't."

"Could it be possible that you simply don't realize that you were not acting in a professional manner and that, in fact, you may be innocent by some act or acts of omission or commission which you may not be aware of?"

"With all due respect for what you are trying to do for me, I have a number of years' experience as an aviator and I think I would recall any such acts."

Glancing toward the trial counsel's table, Major Upright asked, "Tell me, then, Major Fairman, how do you spend your free time?"

Captain Kalastung, watching and listening intently, leapt to his feet. "I object, Your Honor! That question is irrelevant!"

"On the contrary," Major Upright cut in. "It is highly relevant, as I'll soon point out."

"Objection overruled," the judge responded.

"Thank you, Your Honor. Now, Major, will you please tell the court how you usually spend your free time."

"Well," Major Fairman began, "my routine varies. Generally, I stop over at the club after duty, then go home for supper. After supper, I usually read the paper and catch the evening news on TV. We play bridge one evening a week and bingo another evening. On Fridays or Saturdays, we dine out and go dancing."

"What about the rest of the week?" Major Upright prodded.

"We generally stay home. I usually tinker with my Hi Fi equipment or work on model aircraft. We occasionally go boating and do some fishing during the summer months. Some weekends, we drive to the beach and loll around in the sun."

"In other words, you don't have any organized routine for a physical fitness program."

Major Fairman appeared stunned. He hadn't really given the matter any thought. Major Upright continued. "Tell me, Major, what time do you usually go to bed?"

Again, Major Fairman hesitated. "That varies, too. On bridge nights, it's usually 12 or 1 before the party breaks up. I generally make it to bed by midnight on bingo nights. The rest of the week I'm usually asleep by 11:30 or 12, but I generally sleep late on Sunday morning."

"Would you say, then, that you average from 5 to 6 hours' sleep a night during the work week?"

"About that."

"How much sleep did you get on the night preceding this flight?"

"I had several things I wanted to do before leaving and it was about 10:30 before I got them done. Then, there was a special newscast I wanted to watch on TV. It was over at 11:30. I took a shower and went to bed about midnight."

"What time did you get up?"

"I set the clock for 4:30. I live off post."

"In other words, you had approximately 4½ hours of sleep on the night before the flight?"

"That's right."

Major Upright put his hand in his pocket and felt

the crumpled piece of paper he had scribbled on. "In your previous testimony, you said that you went to operations, checked the weather, completed the usual forms and filed your flight plan. Then you went to the cafeteria and had breakfast. Will you please tell the court what you ate."

"I wasn't particularly hungry. I just got a couple of doughnuts and a large cup of coffee."

"Is that all?"

"Well, I got a refill on the coffee and smoked a couple of cigarettes. About that time, a friend of mine, Colonel Dale, came in to eat. Since it was still early, I had another cup of coffee and a cigarette while we talked."

"What about your crew chief? He said that he went directly to the aircraft and had it ready when you arrived."

"That's right. The cafeteria wasn't open when he went to the airfield."

"When did he eat?"

"He didn't. I told him to go on over and pick up some doughnuts or coffee rolls, but he said he'd just wait."

Major Upright approached the judge's bench and turned toward the board members. "Gentlemen, here is a man," he pointed to Major Fairman, "who is accused of professionalism. Yet, before this flight, he had only 4½ hours of sleep, ate two doughnuts and drank three large cups of coffee for breakfast, smoking numerous cigarettes. He has no systematic physical training program. I ask you, how would a professional athlete fare on the same diet and amount of sleep?"

"I object!" Captain Kalastung exclaimed. "This man is comparing an aviator to a professional athlete! An athlete is physically involved in his sport and

must have stamina, coordination, judgment, endurance—"

"That's exactly why it's doubly important for an aviator!" Major Upright beamed as he swung to address the board. "He must maintain a rigid balanced schedule, including proper diet, as well as ample exercise and rest. A pilot *must* have stamina, coordination, endurance and judgment. An athlete in poor condition performs poorly and can cause his team to lose. A pilot in poor condition can cause the loss of an aircraft and its occupants!"

Major Upright paused to allow the board members to digest his words, then continued. "You're all associated with Army aviation. You don't need a flight surgeon to tell you about the effects of hypoglycemia, caffeine, nicotine, carbon monoxide, lack of exercise and loss of sleep. Each of these produces its own harmful effects on the body. Combined, these effects are intensified and can be extremely hazardous. No," he paused again, "the prosecutor is wrong. It is more important for the professional pilot to stay in good physical condition than it is for the professional athlete. He carries considerably more responsibility."

Major Upright strolled to the defense table, lifted a pad and returned to his position before the board. "Statistics show that many incidents result from pilot error during forced landing situations." He glanced at the legal pad. "Investigation reveals that in many of these, underlying cause factors include fatigue, error in judgment, slow reaction, poor coordination—all caused from the conditions we've been talking about."

Major Upright pivoted and jabbed an accusing finger at the defendant. "We have seen that Major Fairman here and his crew chief acted in a highly unprofessional manner before the flight! Nor did it stop there. I will show how their nonprofessional actions were carried into the actual flight."

"In your previous testimony, Major Fairman, you stated you performed a thorough preflight. Is that correct?"

"Yes."

The major walked to the covered stand, rolled it before the judge's bench and removed the cover. "This is a fuel tank I borrowed from the Department of Maintenance. It's used to instruct mechanics. I'd like you to pretend that this fuel cell represents your aircraft tank. Major Fairman, will you please step over and inspect it just as you did during your preflight."

Major Fairman rose, stepped from the witness stand and strode to the mockup. Without hesitation, he twisted the cap off, checked the contents of the tank, then reinstalled the cap, making certain it was secure, with the index marks aligned. He stepped back.

"Thank you, Major. Please take the stand again." He waited until Major Fairman climbed back into the witness chair. "If it pleases the court, I would like to have Sergeant Trotter do the same thing."

At a nod from the judge, Sergeant Trotter rose, walked to the mockup and performed the task in an identical manner, then returned to his seat.

Major Upright turned to the defendant and asked, "Major, if this tank had been in your aircraft, would you have flown it?"

"Yes, the tank was full."

"How about you?" He turned and pointed to Sergeant Trotter.

"Yes, sir. Everything was in order."

"I'm afraid you wouldn't have gone very far. It's filled with water."

"Well, ah, I assumed," Major Fairman stuttered, "it was fuel, as it would have been in the aircraft."

"That type of assumption can be highly unprofessional, Major!" With that, Major Upright drew a back issue of the Army Weekly Summary from between the leaves of his pad and handed it to the judge. "I would like for you to read the brief I have circled. This was a U-8 precautionary landing. Both engines developed high cylinder head temperatures and lost power. The engines had to be replaced because of damage from severe overheating. The cause? This aircraft had been serviced with JP-4 fuel."

He turned and faced the witness. "You see, Major, neither you nor your crew chief were professional in performing your inspections prior to flight."

Major Upright strolled to the defense table, dropped his pad and returned to the witness. "Now, Major, let's go into your flight. Previously, you stated that you did not deviate from your route."

"That's right."

"At what altitude were you flying?"

"Three thousand feet."

"Why did you select that altitude?"

"Because most of the terrain we were to fly over was wooded. I selected 3,000 feet so we could reach a clear area in case of a forced landing."

"Very commendable. Did you stay at 3,000 feet during the entire flight?"

"Most of it."

"What do you mean, most of it?"

"Well, the sergeant and I had been discussing the sensation of speed and how it varies with altitude. To break the monotony, we came down to about 200-250 feet above the tree tops. At that altitude,

we were clear of wires or obstructions."

"Yes, that's true. But a moment ago, you said the reason for choosing 3,000 feet was the possibility of a forced landing. Could you have made it to an open field from 200-250 feet if your engine had failed?"

"No."

"Do you consider that a professional action?"

"I suppose not," the major replied.

"Did you relinquish control at any time during your flight?"

"Not while we were low level."

"But you did let the sergeant handle the controls."

"Yes. He's done it before and we were at a safe altitude."

"Are you a rated IP?"

"I have the qualifications."

"But are you designated as an IP?"

"No."

"In other words, you're not an IP and you were not on a training flight. Yet, you allowed a nonrated individual to fly during your assigned mission?"

"Yes."

"Your Honor," Major Upright turned toward the judge, "I have copies of a collateral investigation brief which I will pass out to you and the members of the board." He walked to the table, opened his briefcase and withdrew some stenciled sheets. "A pilot and passenger were the only occupants of an aircraft which crashed during a cross-country flight in clear weather, killing both and destroying the aircraft. Although the accident investigators could not definitely determine the cause, they eliminated the possibility of mechanical or materiel failure and were unanimous in their decision that, and I quote, '. . . All evidence indicates the passenger was operating the controls at the time of the crash . . .' "

He handed a copy of the brief to the judge and the remainder to the president of the board, then returned to Major Fairman. "Major, witnesses have stated that you and the sergeant were properly outfitted for the flight. What I would like to know is did you or the sergeant remove any of your protective clothing or equipment at any time during the flight?"

"No, not during the flight."

"I have a witness in this courtroom who told me the sergeant was not wearing gloves when you were parking the aircraft. Is this correct?"

"Well, yes," the major hesitated, "but that was after the flight. Sergeant Trotter usually gets the forms out and makes entries while I'm hovering and parking."

"Thank you." Major Upright walked to his briefcase, drew out a sheaf of Weekly Summaries and riffled through them. He selected one with a photograph on the cover and held it up before the judge. "Your Honor, this is a picture of a man's hands. As you can see, they're severely burned. This man was reported to be very conscientious about flying. He always wore protective clothing and wore it correctly. Yet, he did exactly what Sergeant Trotter did. When the aft wheels of his CH-47 were on the ground at the end of a flight, he removed his gloves to fill out some forms. At that time, a control problem developed and a major accident and fire resulted. This man sustained 3rd degree burns to both hands. He had no other injuries. This is an excellent example which proves that no flight is over until the air-

craft is on the ground with the engine or engines shut down and all propellers or rotor blades stopped." He handed the publication to the judge, then returned to the major. "Thank you, Major. You may step down."

Major Fairman climbed down from the witness chair and resumed his seat at the table. He and the sergeant exchanged glances, but neither spoke.

Major Upright addressed the judge. "I'd like to call Sergeant Seay to the stand."

"Sergeant Seay will take the stand," said the judge.

The lean man in charge of the crew which had brought the fuel cell mockup rose and walked to the witness stand. After he was sworn in, he took his seat.

Major Upright asked, "What is your job, Sergeant?"

"I'm the chief inspector in charge of quality assurance at this installation."

"Before coming to this courtroom, you were requested to perform an inspection, were you not?"

"I was."

"Did you perform this inspection?"

"Yes, sir."

"Will you please tell the court about it."

"I was requested to take an inspection team to the UH-1 in which Major Fairman and Sergeant Trotter arrived and perform a thorough inspection of the aircraft, its forms and records."

"What did you find?"

Sergeant Seay produced the envelope he had previously shown the major and opened it. "I've prepared a report of the results. Briefly, my team and I found 15 discrepancies." He handed the report to Major Upright.

"Objection!" Captain Kalastung sprang to his feet. "This is nitpicking! Anyone knows you can find discrepancies on *any* aircraft if you keep inspecting it over and over—scratched paint, dents or any of a dozen other things. I dare say I could personally go over the aircraft right now and come up with additional discrepancies, even following a professional inspection team."

The judge peered at Major Upright who retorted, "Your Honor, what the prosecutor said is partly correct. Nothing can ever be perfect. But I'd like to call the court's attention to only two of the 15 discrepancies found. First, an MWO requiring modification of the doors to prevent accidental loss had not been complied with on this aircraft. Not only that, this MWO had never been entered in the aircraft forms. As crew chief, Sergeant Trotter must accept responsibility for this omission. I don't think I need to remind you of the seriousness of this. Many mishaps, including fatal accidents, have resulted from in-flight door losses."

Major Upright continued. "Second, an extremely serious discrepancy was uncovered by inspection—a small crack on one of the rotorhead trunnions. Failure of any of these trunnions during flight will cause complete loss of control and result in a crash. I would like to point out that, even if the crack formed during the flight to this station, the sergeant should have spotted it during his postflight inspection, which he completed and signed before leaving the aircraft.

"Your Honor, if the court wishes, it will be a simple matter to locate and subpoena witnesses to support the facts I have presented. However, in view of the evidence, I move that the charges be dropped and the case dismissed. It should be obvious by now that neither Major Fairman nor Sergeant Trotter could possibly be guilty of professionalism.

"Further, I'd like to recommend, in the interest of saving time and money, that this law making professionalism a crime be reviewed, with the idea of abolishing it. The few, if indeed any, convictions which might possibly be obtained would not warrant the costly, time-consuming trials necessary to bring them about."

It was all over. Major Fairman and Sergeant Trotter were silent as they left the courtroom. Each had come to depend on the other—to trust him as a professional. Major Upright had destroyed this faith.

How about YOU? If you were on trial for displaying professionalism in your job, would there be enough evidence to convict you?

William P. Christian
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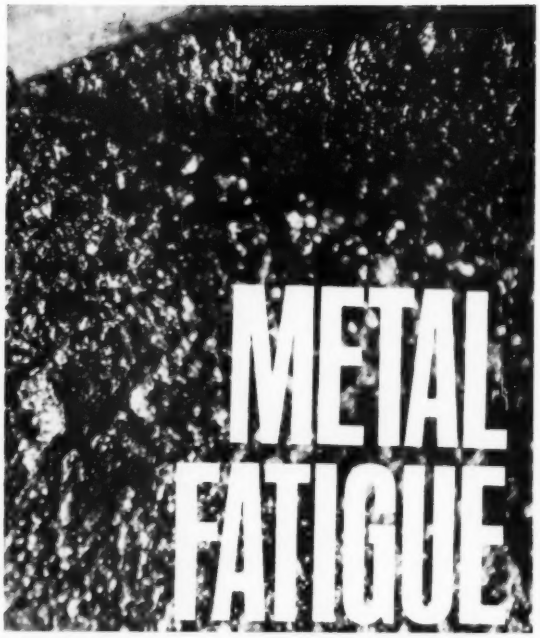

METAL FATIGUE and the accident investigator

A LIGHT observation helicopter departed its home base early one morning for a routine dual training mission. During the first hour, the instructor pilot demonstrated takeoffs, approaches, landings, autorotations, traffic patterns and simulated forced landings to the student pilot. Then the student pilot performed a straight-in autorotation to an assigned landing lane. With the helicopter at rest on the lane, the instructor pilot took control and applied pitch and power to lift to a hover. As power was applied, the tail rotor and boom pivoted counterclockwise and upward into the main rotor blades, causing major damage.

The aircraft accident investigation board established that the forward end of the left tail boom tube strut assembly had broken at the attaching bolt hole. The investigation could have stopped at this point and a determination made that the factor causing this accident was materiel failure and that suspected metal *fatigue* weakened the left tail boom strut assembly at the forward attaching point. This caused separation of the tail boom assembly when the instructor pilot attempted to lift the helicopter to a hover.

But let's not stop here. The purpose of an accident investigation is not only to determine *what* happened, but to determine *why* it happened and *how* it can be prevented. The collection and evaluation of all pertinent data by thorough investigation is essential to ensure that all facts are known. An analysis or metallurgical examination of the failed components or parts may be required to determine all cause factors. In some cases, a metallographic examination may not be necessary because the type of failure is obvious by visual examination. However, the finding of a fatigue area does not, in itself, properly define the cause of the accident. If a component has been subjected to maintenance or operational malpractice, the real cause of a fatigue failure could be the malpractice. Or the cause of failure may be improper design, manufacturing imperfections or an unrealistically established service life. Without a complete investigation, such problem areas will not be properly evaluated and the time and effort expended in the investigation will be wasted.

In most instances, accident investigators do not have the necessary facilities to perform a complete

examination of failed components or parts. However, they can obtain much information that will aid in determining the types of failures and the reasons for the failures. This information should include an accurate description of impact and postcrash fire conditions. These conditions have a direct bearing on damage sustained by failed components or parts. Weather conditions at the time of the accident should also be noted. The effects of exposure must be taken into consideration during metallurgical examinations. For example, if the failed part shows signs of corrosion or rust, it must be determined whether this occurred before or after the accident.

Investigators must also examine aircraft to determine whether any unauthorized modifications have been made. This data is needed to determine whether failed components or parts could have been subjected to a higher stress level than they were designed to withstand. All maintenance work orders (MWOs) must be reviewed to determine if there are existing MWOs applicable to the aircraft or the components or parts suspected of failure. Noncompliance with applicable MWOs can be of major significance to failures.

Prior to submitting suspected or known failed components or parts to a laboratory facility for analysis to determine the cause of failure, proper identification must be accomplished. This includes identifying the items with the proper part numbers and serial numbers, and listing type, model and serial numbers of aircraft in which components or parts were installed. The components or parts must then be tagged with this information.

Pertinent information which investigators must obtain includes the total time on the components or parts, the time since their last inspection and the time since last overhaul. These three time factors must be determined and the information submitted with components or parts if at all possible. Obtaining these time factors is of special importance if *fatigue* is suspected as the cause for failure. Any metal part may fail in fatigue if it has been subjected to repeated stresses long enough.

Other items investigators should consider when submitting parts for final metallurgical analysis are: description of required analysis (a brief description of the analysis requested or, when applicable, the extent of the analysis desired); a contact point (name and telephone number of the individual to be contacted for additional information); notifying the laboratory facility that the component or part has been shipped to their organization; and obtaining a USABAAR or theater control log number for each item selected for analysis.

It is recognized that in some cases it is impossible for investigators to obtain all of the above data. However, every effort must be made to obtain this data before components or parts are shipped for analysis or as supplemental information at a later date. If this information is not submitted with failed components or parts, time, effort and money are wasted. When facts are obtained by investigators and submitted with the failed components or parts, examination and determination of the probable causes for failure will in most cases be determined without delay. Moreover, appropriate corrective action can be taken and this is the real purpose of the investigation.

Back to our original story concerning the fatigue failure of the tail boom strut tube attaching fitting—the accident investigation board sent the failed component to the appropriate laboratory for a metallurgical analysis in compliance with the required data. The findings of the laboratory confirmed the fact that the tail boom strut failed due to fatigue mechanisms caused by bending loads. Further investigation revealed that the fatigue failure originated not as a result of design, manufacturing imperfections or operational malpractice, but rather as a result of the strut attachment fitting being bent each time maintenance personnel replaced a tail boom assembly. As the old saying goes, "any metal subjected to undue stresses long enough will fail in fatigue."

In this accident, the cause factor and the necessary corrective action to prevent recurrence would never have been known had the investigation board stopped its investigation without a thorough and complete examination of the *suspected* fatigue which caused the component to fail.

References: AR 95-5, AR 385-40, AR 17-76, TM 38-750, SL 65-69.

Aviation accident prevention is not an end within itself. It is the by-product of efficient organizational management. One step toward reaching this goal is effective use of aviation safety officers

HELP YOUR ASO DO HIS THING

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MR. COMMANDER, your aviation safety officer is a vital part of your management staff. He should be an extension of your office, working to increase efficiency within operational limits of personnel and equipment resources. He should continually observe the entire command to ferret out operational problem areas, investigate the problems to determine the sources and related functions and

HELP YOUR ASO

coordinate with command and staff agencies to arrive at feasible fixes or corrections. He should then bring these to the commander for approval and implementation.

Your ASO should establish methods for measuring the unit progress in the accident prevention field. The application of statistics will do the trick. Basic figures for accident rates, dollar costs per flying hour and numbers of injuries and fatalities will produce measuring devices that indicate improvement or decay. This information should then be related to mishap cause factors. Further breakdown of these causes and the reasons for them will yield more specific areas for corrective action. The magnitude of problems and their impact on resources should be studied to establish priorities and determine the extent of actions.

When problems cannot be solved at the local unit level, the aviation safety officer should seek the advice of technical representatives, highly experienced operating personnel, senior maintenance officers and others in developing corrective procedures. Extreme care should be used to avoid creating equal or more hazardous situations when this type of action becomes necessary. A solution of this nature should be temporary until higher commands develop the final fix.

Aviation safety officers should continually seek better and simpler methods to accomplish the overall unit mission. They should listen carefully to operational personnel about problems they encounter. They must be able to differentiate between chronic gripes and real problems. One method of doing this is to weigh the problems against the unit's mission and ask for suggested solutions.

The ASO must also develop a method for rapid output of information to operating personnel. Telling people to "fly safe" all the time won't cut it. But telling them the problems, the solutions and the logic behind the solutions will result in cooperation, understanding and rapid implementation of better procedures and techniques. Suggested media include briefings, bulletin boards and safety letters.

An ASO must develop a helpful attitude to gain the confidence of his colleagues and obtain information about problem areas before these areas develop into aircraft mishaps. One of the best methods to gain the confidence of the organization and personnel is diligent work in ferreting out problems, finding feasible solutions, getting them implemented and giving the results back to the individuals or groups who were interested in the problem to begin with. Always follow up on this type of action to measure its effectiveness.

EXAMPLE CHART

TYPE HAZARD	AIRCRAFT TYPE, MODEL, SERIES, UH-1H			
	1ST WK.	2ND WK.	3RD WK.	4TH WK.
MIDAIR COLLISION	XX	XXXX	XXXX	
INADVERTENT IFR		X	XX	
TAXI COLLISION	X		X	
POWERPLANT	X	X	X	
HYDRAULICS		XX		
REFUEL	X		X	

The effective use of the operational hazard report (OHR) is an outstanding method for obtaining information about latent problems. The OHR system is outlined in AR 95-1, Chapter 4, paragraph 4-7. This regulation prescribes the use of DA Form 2696 for reporting hazards that can develop into aircraft mishaps. This is a most important function within any aviation accident prevention program. Unfortunately, it receives very little attention. Why? Generally, because of a lack of knowledge on the part of commanders and safety officers about how to employ this tool for its optimum benefit.

The reasons for hazard reporting by operational personnel must be fully explained to them. First, it is their method of alerting the command to problems which affect their safety and the unit's mission capability. Second, recurring hazards are readily recognized and immediate action can be taken to correct conditions which create these hazards. Third, every

corrective action widens the margin of safety for all flying personnel. Some common objections from aviators are lack of time to do the paperwork (the lazy man's excuse), lack of proper forms (every aviator should keep one with his flight gear) or they don't see why one hairy near accident is so important (they need to see the big picture—if the same thing is occurring to others, all will soon be in trouble).

The ASO should furnish his commander with an SOP requiring implementation of the OHR system. He should also explain that it is much better to spend man-hours analyzing hazard reports than to spend man-hours investigating losses due to aircraft accidents. The OHR system does not deplete combat resources. Accidents do.

Commanders may wish to know what the OHR system can do for them.

- It alerts the command to operational problems before they become catastrophes.
- It gives the commander a feel for the real problems his air crews and maintenance people face.
- It furnishes him with trend information that shows immediate and most important problem areas. This helps to establish priorities for action.

Other commanders are concerned with how the OHR system can be made to work for them. They must first supply strong command emphasis to get their personnel to submit OHRs. The ASO should then analyze the reports, grouping them by type, model and series of aircraft; geographic location; type of hazard; conditions of flight; mission; weather; phase of flight; aircraft system involved; and time of day. One method of accomplishing this is to establish a chart listing the broad scope of types of hazards vertically (i.e., midair collision, inadvertent IFR, powerplant, hydraulics, refueling, etc.) as they are reported. The type, model and series of aircraft can be listed horizontally for chart identification. The blocks across the top can be labeled by the weeks of the month.

In the example chart, it is apparent the midair collision potential is climbing rapidly. A review of OHRs may well identify a particular area, such as a NAV aid or the traffic pattern to a refueling area. Better traffic control or a new or different approach pattern would probably solve the problem. Failures of aircraft systems which do not result in mishaps are good indicators of a need for improved maintenance procedures, better supply procedures or a change to publications. If immediate corrective action isn't taken, aircraft mishaps may result.

Correct evaluation of the OHRs is most important. The aviation safety officer need not wait for several occurrences before deciding it's time for action. One near midair collision in a controlled area can show that a traffic pattern design must be corrected. One critical system malfunction can reveal a need for an immediate one-time inspection of similar systems in other aircraft. In general, the OHR system will identify problems that can be corrected rapidly at the unit level. This gives the commander a tool to alert the organization about problems that could easily deplete his resources if they go uncorrected.

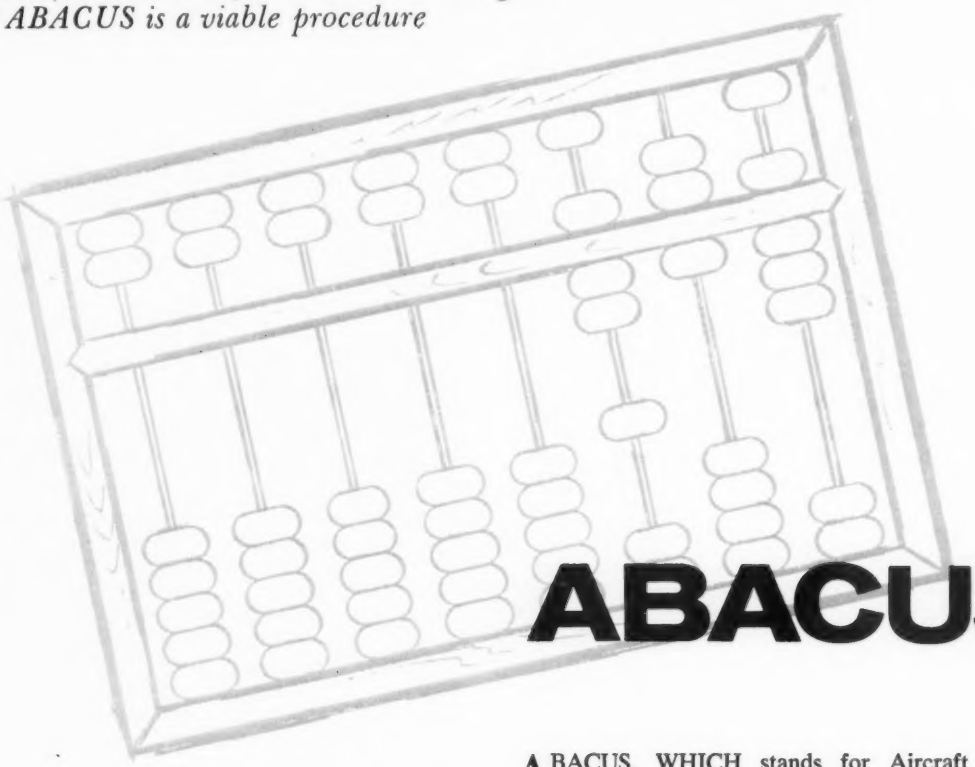
An astute aviation safety officer can get a feel for the rate the mishap potential is growing in a particular type hazard and bring this to command attention for urgent action, as required. A chart should also be used to keep a running record of forced and precautionary landing cause factors. These ready references are vital to keep the commander abreast of his command's performance.

Commanders and aviation safety officers must not be led down the primrose path to complacency by appraising mission accomplishment against existing hazards. The goal is to clean up hazardous areas so that mission accomplishment can be even more productive, at the same time reducing risks of unnecessary loss of lives, equipment and combat capability.

Aviation safety officers can be extremely valuable in assisting aircraft accident investigation boards or officers. It is to a commander's advantage to know the real reasons for an aircraft mishap and do all in his power to correct the situation. In the event he cannot accomplish all required action at his level, he should have an ironclad case to present to higher headquarters to obtain help in solving the problem.

Commanders may delegate authority to ASOs to investigate any area which may create hazards to flight. However, responsibility for conservation of lives, materiel and combat capability remains a function of command. Commanders must fully accept this responsibility if their organizations are to successfully accomplish their missions. Helping their ASOs do their thing can be a giant step in this direction.

Those familiar with the storage, retrieval and analysis of aircraft accident information will recognize that ABACUS is a viable procedure



ABACUS

Emil Spezia
Plans and Programs Department
USABAAR

ABACUS, WHICH stands for Aircraft Basic Accident Causes, U. S. Army, is a simple concept, a language for encoding cause factors of aircraft accidents. These factors are the conditioning events of every accident which precede the critical event which makes the accident unavoidable.

USABAAR developed ABACUS because of its need to encode a more detailed description of these events. Replication of these events upon retrieval from the data bank is a prime requirement. Otherwise, the intricate interrelationship of *man, machine* and *environment* found in accidents is not preserved, particularly in a form suitable for analysis. Information extracted from these events serves many purposes, all in support of the Army's aviation accident prevention program.

Like other aviation accident research agencies, USABAAR has recognized for a long time that event descriptions stored in punched cards were not adequate for many of these uses. USABAAR's encoding procedure, prior to ABACUS, had been to select a statement from a list of prepared statements, using the one which best described the event. That method, essentially a "laundry list" of relatively rigid somewhat independent statements, mainly addressed de-

scriptions of aviator performance. For example, a statement was first selected to describe the general unsafe act (e.g., "Failed to maintain flying speed"), then a statement to describe a particular performance (e.g., "Failed to maintain rotor rpm"). ABACUS, in contrast, is based on a key word concept. Key words, as will be shown, are selected to construct each statement. ABACUS also encodes the events in sequence, with a reason for each event. In addition, to serve the many and varied uses of this information, it is possible to retrieve each event, not by a single code, but by the code assigned to each key word. Whether the purpose is to determine the "state" behind the act, to identify underlying variables, to categorize accidents in terms of what could have been done to prevent them, or to attempt to determine ultimate causes—each event is accessible with relative ease.

ABACUS statements, except for nomenclature for the aircraft (the machine), are prepared from approximately 650 key words and phrases. Because it is possible to construct almost an infinite number of combinations, a count of the aircraft descriptors has not been made. The code structure developed for this purpose is a much abbreviated modification of the aircraft parts catalog system.

Two examples of ABACUS in computer printout form that describe the events of two accidents are shown. Example I was prepared from crash facts message information that describes an occurrence which should be familiar to many rotary wing aviators. Note the column titled "Role," located to the left of the column titled "Field Name." The "D" entered in that position indicates that "engine/power plant stopped" was a *definite* factor in the cause of this accident. Had an "S" appeared in that position, its role would have been *suspect*. An "R" in that position, shown in the last entry of each example, stands for *result* (i.e., the end result of the engine-stopped event was "Airframe struck obstacles*tree(s)."

To help explain the "why" or the "state" behind an act, ABACUS requires a categorical reason to be encoded. The reason the engine stopped had not been determined by the unit when they prepared the crash facts message. In lieu of a reason, "pending analysis" was entered to indicate an effort was underway to determine the cause.

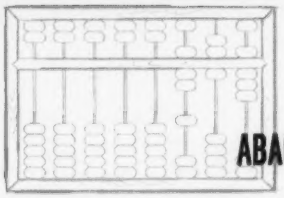
"Obstacles*tree(s) obstructed LZ, PZ, DZ," example 1, and "Obstacles*ditch/gully obstructed forward position," example 2, illustrate the often overlooked part environment plays in Army aircraft accidents. Hopefully, with access to additional information of this type at computer speeds, the whole problem of aircraft accidents will be better understood.

ABACUS, as may be noted in these examples, provides more than just a description of an event. The phase of operation field, for example, pinpoints a point in time in terms of aircraft operation when each event occurred. This feature, in terms of aiding analysis, is perhaps one of the most useful features ABACUS has revealed to date.

The *subject* and *main object* of ABACUS statements, shown in the examples, names only MAN, MACHINE (the aircraft) or elements of the ENVIRONMENT. Man, used only as subject, is de-

EXAMPLE 1

ROLE	FIELD NAME	CODE	DESCRIPTION
D	PHASE OF OPER	6CN1	INFLIGHT*CRUISE*NORMAL
	SUBJECT	M03	ENGINE/POWER PLANT
	ACTION VERB	S18	STOPPED
	REASON	P1	PENDING ANALYSIS
D	PHASE OF OPER	7BE1	LANDING*TOUCHDOWN*EMER AUTO
	SUBJECT	EOT3	OBSTACLES*TREE/S/
	ACTION VERB	O03	OBSTRUCTED
	MAIN OBJECT	EFL5	LZ,PZ,DZ
	REASON	E2	ENVIRONMENTAL
RESULT	SUBJECT	M01	AIRFRAME
	ACTION VERB	S21	STRUCK
	MAIN OBJECT	EOT3	OBSTACLES*TREE/S/



scribed by one of 47 duty titles, i.e., instructor pilot, control tower operator, ground commander, air mission commander, mechanic, etc. The environment list of 137 words contains such words as heliport, departure zone, crash rescue, in addition to terrain and meteorological features normally associated with environment.

Action verbs that describe the act of the subject are selected from a list of 175. These verbs that range from "accelerated" to "wobbled" have been carefully chosen for their common usage connotation and ability to convey aviation terminology.

Example 2, derived from an accident report, not only shows additional information available from a completed report, but also reflects a higher degree of analysis possible to encode. This example also shows additional fields, the *subject manner, object manner, subject position/condition, object position/condition,* and *object qualifier,* in addition to the reason fields used in preparing ABACUS statements. The subject manner field describes the manner of the subject's act. An entry in this field is permissible only when the subject names either man or environment, but not when it is some part of the aircraft. Words such as abrupt, insufficient and substandard, which are selected from a list of 19 words, are found in this field. Not illustrated in these examples, these same words are also used to modify the object, but only when the subject is either man or the environment.

The position/condition field is a combination descriptor field as its title indicates—words selected to modify either the subject or object. In the two positions for this field, the word choice is limited to two. The word list of 114 contains such "position" words as aft, above, vertical, etc. "Condition" words are emergency, freezing, empty, hot, etc.

The object qualifier field, as do the other fields governed by the ground rules, serves a unique purpose. Heading, air speed, ground resonance, power, water, wear, etc., are some of the 71 words used only as objects. The rules prohibit their use as a *main object.*

Those familiar with the storage, retrieval and analysis of aircraft accident information will recognize that ABACUS is a viable procedure. It lends itself to quality control measures, eases the retrieval task and encourages analysis because otherwise complex events are broken down into a singular act found in each ABACUS statement. Eventually, the events of each and every accident back to some yet undetermined date will be accessible by key word or phrase, by their positions in the fields shown in the two examples. The impact of this potential on USABAAR's ability to respond to the needs of the Army's aviation accident prevention program is beyond comprehension at this time. That realization will come within the next few years when USABAAR's information management system, including a total revamp of the accident data base of which ABACUS is just a part, is fully operational.

EXAMPLE 2

EVENTS	ROLE	FIELD NAME	CODE	DESCRIPTION
R 1 1	D	PHASE OF OPER	7AA1L1	LANDING*APPROACH*AUTOROTATION*LOW LEVEL
		SUBJECT	PIP	INSTRUCTOR PILOT
		ACTION VERB	I02	INITIATED
		SUBJ-MANNER	I1	IMPROPER
		SUBJ-POS/COND-1	L09	LOW
		SUBJ-POS/COND-2	L06	LEVEL
		OBJ-QUALIFIER-1	P6	PROCEDURE/S/
		REASON	E3	EXPERIENCE
R 1 4	D	PHASE OF OPER	7BE1	LANDING*TOUCHDOWN*EMER AUTO
		SUBJECT	EOD1	OBSTACLES*DITCH/GULLEY
		ACTION VERB	003	OBSTRUCTED
		SUBJ-POS/COND-1	F01	FORWARD
		OBJ-QUALIFIER-1	P4	POSITION
		REASON	E2	ENVIRONMENTAL
RESULT	R	SUBJECT	EOS1	OBSTACLES*STUMP/S/
		ACTION VERB	P09	PUNCTURED
		MAIN OBJECT	M100121	FUEL SYSTEM*SUPPLY*TANK

KUM

USABAAR receives many calls concerning procedures for submission of components for analysis. Here's the straight poop

ANALYTICAL TEARDOWN AND ANALYSIS

CW3 Arel E. Childress
Aircraft Accident Review and Analysis Department, USABAAR

SAFETY OFFICERS, maintenance officers and presidents of aircraft accident investigation boards —lend an ear! An Army aircraft accident has occurred and the investigation has been in progress for several days. The accident investigation board suspects the accident was caused by engine failure during takeoff. There was no visible damage to the engine. The pilot reported no malfunction prior to the crash and there was sufficient fuel aboard. Cause of engine failure—unknown. Next step—analytical teardown and analysis.

USABAAR receives many calls concerning procedures for submission of components for analysis. Here's the straight poop: AR 95-5, Change 1, dated 9 July 1969, and Supply Letter 65-69, dated 27 August 1969, outline step-by-step procedures for obtaining analytical teardown and analysis of Army aircraft parts and components. These publications authorize presidents of accident investigation boards in CONUS direct communication with USABAAR to obtain oral concurrence for shipment of parts for analysis. The unit maintenance officer may select parts for analysis when incidents, forced landings or precautionary landings are not serious enough to be classified as accidents. The Cargo Division chief, AAR&A Department, USABAAR, has primary responsibility for processing requests for analysis.

The U. S. Army Aeronautical Depot Maintenance Center (ARADMAC) is the prime recipient and evaluator of components. However, the 1st Transportation Battalion (FAMF) (Corpus Christi Bay) and USAMAC (USAREUR) are authorized to analyze certain components. In some cases the aircraft/component manufacturer will perform the analysis (see AR 95-5, Change 1, for details).

In CONUS a call to AAR&A Department, USABAAR, is the first step. If the request is approved, a control log number will be issued. This log number will be given to ARADMAC and AVSCOM and will serve as the control number on all analysis requests. USABAAR log numbers will be assigned as follows:

Example: 70-21
70—Designates calendar year
21—Designates 21st request in calendar year

Example: 70-021
Same as first example except "0" preceding last two digits indicates parts came from overseas.
Example: 70-21f/70-021f
The "f" following last digit indicates parts were sent to the prime manufacturer for analysis.

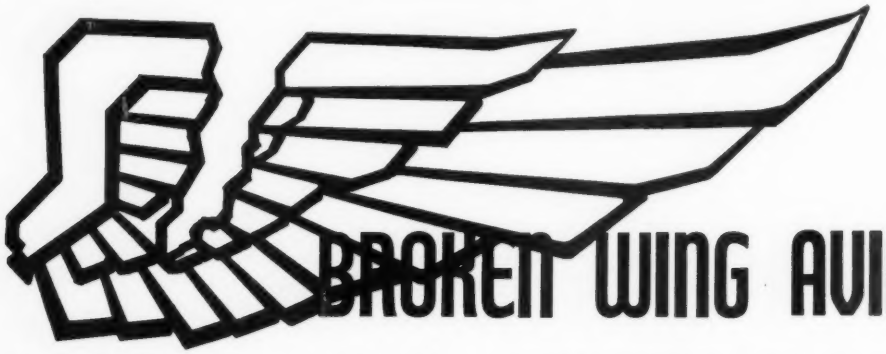
To ensure positive control, USABAAR will call ARADMAC, giving the log number and information concerning the parts being shipped, e.g., aircraft serial number, date of accident, nomenclature of parts, etc. Also, the USABAAR liaison officer at AVSCOM will be notified by letter that the parts are being sent to ARADMAC or the manufacturer. ARADMAC or the manufacturer will notify the commanding officer of the requesting unit when the parts are received and give him an estimated completion date.

After completion of the analysis, a preliminary report will be sent in accordance with AR 95-5, Change 1. ARADMAC will provide three copies of the final analysis report to USAAVSCOM and four copies to USABAAR. In turn, USABAAR will forward one copy to the applicable theater/Army aviation safety officer and one copy to the commanding officer of the requesting unit.

For overseas commands, USABAAR approval is not required. Theater commanders are responsible for approval and establishment of controls to comply with AR 95-5, Change 1. A supplemental crash facts message should be sent to the addressees listed in AR 385-40 when parts are shipped to ARADMAC from overseas. USABAAR will receive only one copy of the final analysis. ARADMAC is responsible for sending copies of the analysis report to the unit making the request. Check your local regulations and SOP for detailed instructions.

USABAAR receives a weekly analysis status report from ARADMAC on parts received, parts pending analysis, parts being analyzed and completed projects. Any inquiries concerning status of projects should be referred to by the USABAAR log number.

The analytical teardown and analysis can be a big asset to aircraft accident investigators and maintenance officers. Follow the proper procedures and watch the results.



BROKEN WING AVIATION

PARAGRAPH d(1), chapter 7, AR 385-10, states that Broken Wing Aviation Safety Award nominations should contain a concise description of the in-flight emergency, including the information required by subparagraphs (a) through (r). USABAAR has received many nominations using these subparagraphs as a reporting format. The information required by these paragraphs was primarily intended to be used as a checklist rather than a format for preparing nominations. However, if this listing is considered more convenient than a narrative, which is the more desirable format, it is recommended that each paragraph be titled. For example, paragraph (f) should read: Number of years as a rated aviator - 3.

Also when using this format, paragraph (n), "Action taken by aviator to cope with emergency," must be expanded. To merely say that a pilot autorotated is not sufficient. An example of the required data for this paragraph is: "When the engine failed, the pilot quickly entered autorotation. He made a 180-degree turn into the wind and tried to increase engine power during descent. When the engine failed to respond, he shut it down. Unable to radio the tower of his emergency due to heavy traffic in the area, he headed towards the only suitable forced landing area, a dirt road bordered by 50-foot pine trees. Maneuvering between the trees, he flared, pulled pitch, landed and skidded to a stop with no damage to the helicopter."

When preparing nominations for the award, do not expect the committee members to surmise what extraordinary skill, judgment and technique an aviator displayed in coping with an emergency. An aviator's actions alone could be the determining factor for approval of the award.

AR 385-10 also requires that a copy of the crash facts message be forwarded with the nomination, except for mishaps resulting from combat. Occasionally, messages do not accompany the nominations. On checking USABAAR files, it is found in most cases that a message has not been received, as required by AR 385-40. When this happens, nominations must be returned to the nominating official until a message is received.

In May and June 1970, the Broken Wing Aviation Safety Award committee reviewed 40 nominations. Eight aviators were selected to receive the award for their actions during the following emergencies:

LIEUTENANT STEVEN J. SCHMIDT was on an OH-6A combat reconnaissance mission in the Republic of Vietnam 20 April 1970. While flying at 30 knots and 50 feet and making a left turn over a bunker, the tail rotor gearbox failed and sheared the aft drive shaft coupling. The helicopter suddenly began turning to the right and pedal application failed to correct the turn. LT Schmidt reduced power and streamlined the OH-6A by increasing air speed. With the tail rotor windmilling, he returned to the nearest airfield and landed without further damage.

WO1 RONALD E. STOKES was on a UH-1H visual reconnaissance mission in the Republic of Vietnam 6 April 1970. During level flight at 60 knots and 50 feet above the trees, his helicopter was hit by small-arms fire. A round shattered the tail rotor servo and severed an engine oil line, causing failure of the tail rotor in a fixed left position and loss of hydraulic fluid and engine oil. WO1 Stokes flew to a small airstrip and landed with no further damage.

WO1 GERALD L. ANDERSON was on a CH-47A combat resupply mission in the Republic of Vietnam 19 April 1970. While he was picking up a slingload from a truck bed, the number two engine failed. He jettisoned the load and attempted to maneuver away from the truck, but the rotor rpm bled

P. R. Thompson

SAFETY AWARD

off and both SAS systems failed. The CH-47A settled on the jettisoned load and the cargo hook became entangled in the banding material. By precisely maneuvering the helicopter without the SAS systems, WO1 Anderson freed the cargo hook and landed in an extremely small area bounded by 10-foot deep ditches without damage.

WO1 ROY A. DOWD was on a UH-1H combat support mission in the Republic of Vietnam 27 April 1970. While climbing out from takeoff, the 90-degree gearbox and tail rotor assembly separated from the helicopter. The UH-1H made a sharp 90-degree turn to the right and WO1 Dowd entered autorotation. He successfully maneuvered the helicopter to a dry, rolling rice paddy and landed without power or further damage.

WO1 DAVID A. TRUJILLO was on a UH-1B training mission in the vicinity of Geneva, Ala., 23 April 1970. During cruise flight at 80 knots and 500 feet over a heavily wooded area, his engine failed. Flying number three position in formation, he made a left turn into the wind, checked the instruments, notified the flight leader of his emergency and aligned the UH-1B with the long axis of an open, cultivated field. He entered a steep deceleration and a 90-degree right turn to avoid wires and 2-foot terraces along his intended landing site. Descending vertically, with minimum forward movement, he applied all available collective at 10 feet and landed upslope with no damage.

CW2 ROBERT WARD GLOMB was on an OH-6A ferry flight from Carlsbad to Stockton, Calif., 9 June 1970. During cruise flight at 500 feet and 110 knots, he felt a severe vibration, followed by loss of directional control and a 90-degree yaw to the right, due to separation of the tail section from the helicopter. He reduced collective and retarded throttle to reduce the yaw. By manipulating the cyclic to maintain directional control, CW2 Glomb autorotated to a sparsely vegetated field and landed without further damage.

CAPTAIN KENDALL NORMAN was on an OV-1C test flight in the Republic of Vietnam 14 May 1970. When retracting the landing gear after takeoff, an unsafe condition warning light illuminated. After exhausting all methods of recycling the gear, CPT Norman flew for 1 hour and 15 minutes to burn off fuel in the drop tanks and notified the tower to foam the active runway. During the approach, CPT Norman had to make a go-around due to heavy rain and deteriorating visibility. On the second landing attempt, he touched down gently on the left main gear and used all available aileron control to keep the right wing up. As the right drop tank contacted the runway, he applied reverse thrust on the left engine to maintain directional control. The OV-1C rolled 1,000 feet and gently turned right, coming to a stop 90 degrees to the right of the landing direction. CPT Norman accomplished the landing with only incident damage.

CW4 HAROLD W. DAVIS was on a CH-47C test flight in the vicinity of Wausau, Fla., 5 June 1970. During cruise flight at 1,500 feet, the number two engine exploded, severing the hydraulic line, impregnating the aft pylon area with shrapnel and violently jarring the helicopter. CW4 Davis landed on a paved road surrounded by forests and cultivated fields with powerlines 5 yards to the front and 100 yards to the rear of the helicopter. Due to inoperative brakes, he stopped the CH-47C by using thrust from the rotor system. When he lowered the thrust lever, the helicopter turned about 120 degrees and slid backwards 10 feet. When he shut down the number one engine, the rotor blades hit the fuselage, damaging the airframe. CW4 Davis, however, displayed extraordinary skill, judgment and technique in preventing injury to his crew and total destruction of the helicopter.

I WAS A

Laurel D. Sand

Life Support Sciences Department
USABAAR

THAT'S RIGHT! I stole! I stole from the flying experiences and the mistakes of others—from their blood, sweat and grey hairs. I was never an exceptional pilot, just average, but I was smart enough to know my limitations and what my aircraft would do. I analyzed my own mistakes, honest, stupid, or both, for a safe solution. But let's go back 27 years.

I started in the Army Air Corps in 1943. In flight school, pink slips (unsatisfactory flights) dotted my grade folder. As time passed, they finally disappeared, except when I became lost on a low level navigation flight 2 weeks before graduation. To add insult to an injured ego, I was awarded a horse collar to wear around my neck for a week. This was to make sure my head stayed in the right place.

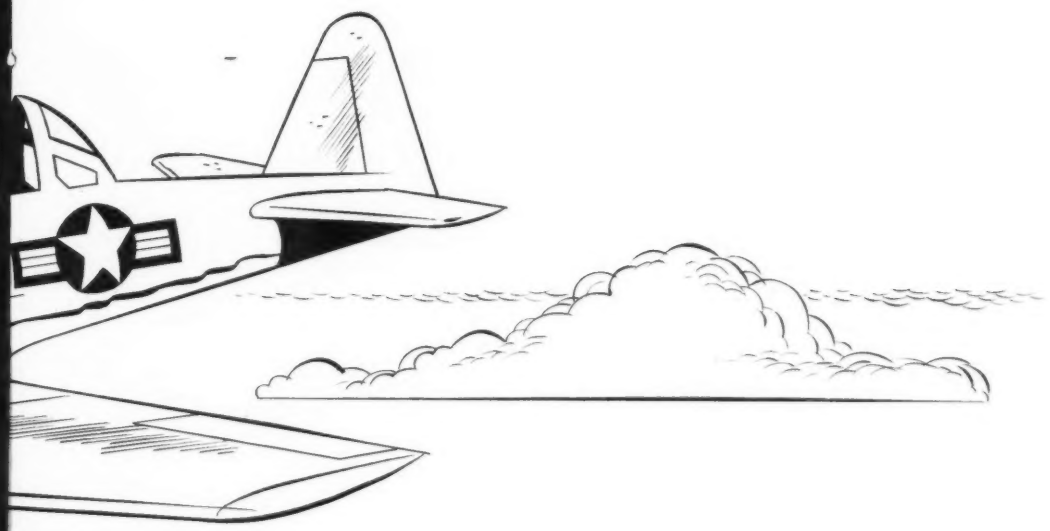
I recovered from this indignity, convinced my guardians were unaware of my abilities. When I graduated I was sure I was the hottest pilot in the sky. I soon became aware that my buddy was a competitor. He was one of those rare naturals who did everything easily and properly. I'll call him Jim. I was determined to show him wrong, without his knowing what I was up to.

Unknown to me, I was a victim of absurd conceit. I was envious of this friend and my envy triumphed over common sense. It was a beautiful day in southern Alabama and Jim and I were flying formation. I was leading. When it was time to return, I gave Jim the signal to break and head home in trail. My plan was to sucker him into a game of follow the leader and lose him. I rolled inverted and split S'd, pulling out right on the deck. I turned my head to locate Jim above me. My snicker was broken off by Jim's voice yelling in my headset, "Sandy! Twelve o'clock!"

I turned my eyes front and saw a barn directly in front of me. St. Peter hurriedly checked his roll and, wonder of wonders, my name wasn't there. I yanked back on the stick and climbed like a homesick angel. I leveled off and heard Jim ask, "You O.K.?" I found my voice and replied, "I'm O.K. I missed it. Let's go home."

After we landed and shut down, Jim came over to my plane where I sat, thinking. He crawled up on the wing and looked up at me, not saying a word. I said, "Thanks, Jim." He still didn't say a word, just gave me a slow, odd, knowing smile. This close call was a sobering experience which turned into a blessing in disguise. I suddenly realized why Jim was such a tremendous pilot. He was deliberate. He planned

PROFESSIONAL THIEF



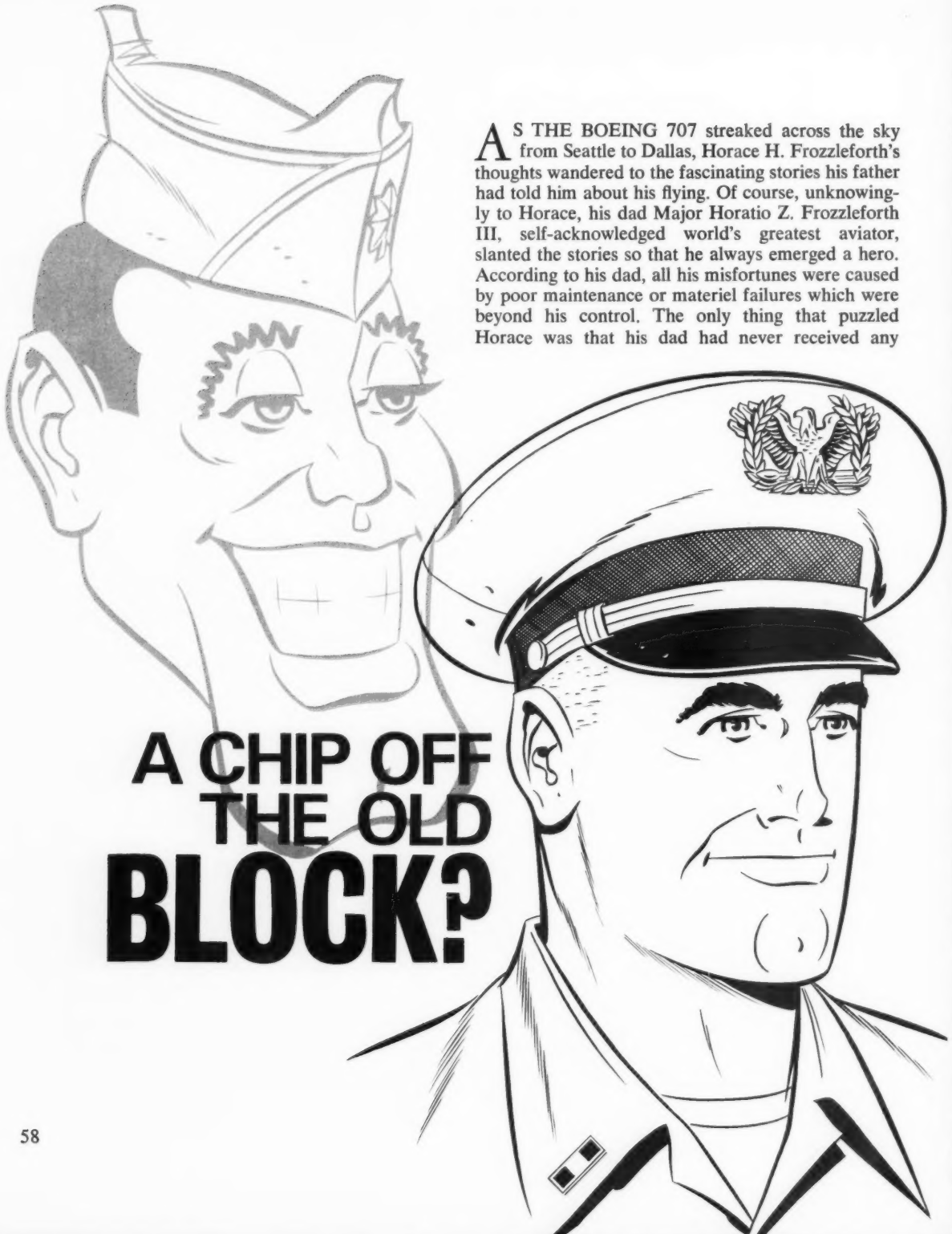
ahead—thought things out. He had imagination.

Over the years I've found that there are two kinds of pilots who have accidents. These are the impulsive ones and the poor ones. The impulsive type is usually better than the average bear. He knows this, but not his or his aircraft limitations. He eventually pushes both beyond their limits. The poor pilot simply lacks ability. One thing both have in common—they lack imagination. While other pilots were busy having accidents, I was busy trying to find out *why* they had accidents. I imagined myself in the same situation and what my corrective measures would be. I listened to the war stories of others and observed their flying habits and usually learned something.

Eventually, I became a helicopter instructor pilot and soon found I still had lots to learn. To be proficient and efficient, many maneuvers were self-taught. I aged quickly. I almost made the exception to that old saying, "You can't possibly make all the mistakes there are to make." However, I felt it was my moral obligation to teach my students everything I could about flying. I could not teach them to be dangerous. It's surprising how much you learn while teaching others and take the opportunity to analyze the mistakes they make. This is a must for an instructor or he simply can't tell his students what they did wrong. Expect them to make mistakes, but not the same one more than once.

After 25 years of flying, I finally hung it up. As I sit at my desk and read accident reports by the hundreds, I've come to one conclusion—we don't need any enemies! I can understand accidents caused by inexperience on the part of the pilot. If it isn't fatal he may learn from his experience. From every accident, incident or less, a lesson can be learned. What I can't understand are the nonprofessionals—experienced pilots who attempt to fly formation with overlapping rotor blades and those who attempt to fly under bridges or attempt to buzz and take along the innocent. It's saddening. Dead pilots have no regrets. They may be more fortunate than the ones who have to live with themselves.

My confession of not being a super pilot is at best an honest appraisal. Other than my close brush with death 25 years ago, I have no hair-raising tales to tell to fellow pilots or the fledglings. But I don't care. In fact, I'm proud of it. My one desire over the years was to survive and help others if I could. The real thrills I got from flying were from dodging other aircraft and seeing my students graduate. My humdrum flying experiences have been most rewarding. I'm proud of my professional thievery.



A CHIP OFF THE OLD BLOCK?

AS THE BOEING 707 streaked across the sky from Seattle to Dallas, Horace H. Frozzleforth's thoughts wandered to the fascinating stories his father had told him about his flying. Of course, unknowingly to Horace, his dad Major Horatio Z. Frozzleforth III, self-acknowledged world's greatest aviator, slanted the stories so that he always emerged a hero. According to his dad, all his misfortunes were caused by poor maintenance or materiel failures which were beyond his control. The only thing that puzzled Horace was that his dad had never received any

medals for his heroism and had been passed over three times for promotion to lieutenant colonel. Knowing his dad was a man of tremendous self-esteem, he never asked questions for fear of deflating Horatio's ego (if that were possible).

The reverse thrust of the 707 snapped Horace back to reality. At the Dallas airport, he and other aspiring aviator applicants boarded a military bus which carried them directly to the personnel section at Ft. Wolters. Horace eagerly jumped out and, head held high, marched into the personnel office. He halted in front of a secretary's desk marked: ALL INCOMING PERSONNEL REPORT HERE.

"May I help you?" asked the attractive young brunette behind the desk.

"Yes, I'm PFC Horace H. Frozzleforth. Here is my personnel file. I'm going through the Warrant Officer Rotary Wing Aviator Course."

The girl's mouth gaped and she looked as if every drop of blood had drained from her head.

"Something wrong?" he asked.

"You're not by chance related to *the* Major Horatio Frozzleforth?"

"As a matter of fact, I am. He's my dad. Do you know him?"

"Not personally, but I've heard lots about him."

"He told me he was well known throughout the Army, but I didn't realize just how well."

"Have a seat," she said. "I'll be back shortly." With his file in hand, she scurried off to the rear of the building and entered a door marked CW4 JACOBSON, PERSONNEL OFFICER.

"Sir, you'll never guess who just reported in," she gasped. "Major Frozzleforth's son!"

The rugged sandy-haired warrant officer behind the desk looked up and his mouth dropped open. "You've got to be kidding!"

"No sir, here are his orders and personnel file."

Glancing through the records, Jacobson exclaimed, "I hope he's not a chip off the old block! The Army can't tolerate another Horatio. I'll call Major Hardshell and alert him that Horace is being assigned to his company. Maybe he can get the young lad started off on the right foot. That is, if it's not already too late. In the meantime, proceed with the in-processing."

Determined to be as great an aviator as his father professed to be, Horace studied intensively during the preflight indoctrination phase. And it was obvious. He completed the 30-day instructional period ranking highest in a class of 200 students.

During the second phase of training, Horace handled the TH-55A as though he were a natural-born aviator. Through his precise by-the-book flying technique, he appeared to be well on the way to becoming a professional in the early stage of his aviation career. The day before leaving for Ft. Rucker, Horace was summoned to Major Hardshell's office. Knowing the major's name suited his personality, he wasted no time in arriving at the major's office. He marched to the desk, snapped to attention and saluted. "WOC Horace H. Frozzleforth reporting as requested, sir!"

"At ease, Horace. What I have to say will only take a few minutes."

Horace's head was filled with all kinds of morbid thoughts and beads of perspiration popped out on his forehead.

"Horace, I thought you would be interested in knowing that I've had nothing but excellent reports from your academic instructor and instructor pilots. It's an honor to have had a student in my company with your stamina, ambition and ability."

"I guess I owe most of the credit to my dad," Horace replied. "Since I arrived here, I've been striving to keep up the good name."

Major Hardshell gasped, speechless. Evidently, the young man had never heard the truth about his dad's flying escapades, he thought. No use marring the boy's idol now. It could ruin his flying career. Maybe a few of Horace's good qualities will eventually compensate for his father's nonsense. Who knows, some may even rub off on Horatio.

"Well, Horace, I wish you continued success during your training at Fort Rucker and in the years to come. The only advice I can offer is to always adhere to the flight techniques you were taught and always fly by the rules. Be confident, but not too confident. Remember—emergencies usually occur when least expected. Good-bye and good luck."

"Thank you, sir," Horace said, snapping to attention and saluting.

Horace was assigned to the First Warrant Officer Candidate Company at Ft. Rucker where he continued to demonstrate the fine qualities and ability he had shown at Wolters. After completing instru-

ment and transition training, the day finally arrived for him to perform his first solo flight in the UH-1B. He arrived at the airfield an hour before his assigned flight time and filed a flight plan with operations for an 0830 takeoff. He then walked to the flight line and performed a thorough preflight inspection of his helicopter. During the inspection, he found the quick disconnect fittings were not properly seated.

"Sure glad I followed the checklist," he mumbled. "Those fittings probably would have caused fuel starvation and I'd have been in big trouble. Now I realize why the schools place so much emphasis on thorough inspections."

Horace returned to operations and asked for a maintenance inspector to be sent out to correct the deficiency. After the fittings were properly secured, he climbed aboard and performed by-the-book prestart and starting procedures. He ran the engine up, hovered to the takeoff position and checked the instruments. All were in the green. He received clearance, took off and headed for a tactical landing zone 20 miles from the airfield. Reaching his destination, Horace made three practice landings and takeoffs. On the last takeoff he turned north and headed for the home field.

He was cruising at 500 feet over a heavily wooded area when the engine suddenly failed. "Mayday! Mayday! Mayday! This is Red 1 going down 3 miles northeast of Tac-Z with engine failure." Simultaneously, Horace turned left into the wind and checked the instruments. Spotting an open, cultivated field, he completed the left turn, aligned the UH-1B with the longest axis of the field and rechecked the instruments. About this time, he saw wires and 3-foot terraces around his intended landing site. He put the helicopter into a steep deceleration, made a 90-degree right turn to miss the wires, applied all available collective, landed upslope and slid 2 feet to a stop. He immediately shut down and climbed out to see if there was any damage. None was evident. Not until then did Horace realize he was trembling.

Help arrived shortly and the maintenance personnel checked out the engine. However, it was not until the teardown analysis that it was discovered the number two bearing had failed.

When Horace reported to his commanding officer, Major Goodson, the next day, he was greeted with a smile and handshake by the stocky redhaired officer. "Horace, I want to commend you for your outstanding performance in handling the emergency yesterday, especially considering your low flight time in the chopper. I think you deserve some type of recognition and I'm submitting your name for the Broken Wing Aviation Safety Award. I can't assure you it will be approved. We'll just have to wait and see."

"Thank you, sir."

The day before graduation, Horace was catching up with his paperwork when he was called to the telephone.

"Mr. Frozzleforth, you have a long distance call on 9823."

"Thank you. Frozzleforth speaking."

"Horace, my boy, I haven't forgotten you!" rang out a familiar voice. "How about picking me up at the Dothan Airport at 1830. This is one occasion I wouldn't miss if it meant going AWOL. It'll be just like old times—I've got so much to tell you!"

"I'll meet you at 1830 sharp," Horace replied. "I have some news for you too. See you tonight."

Flight 129 arrived on schedule and Horatio was the first passenger to appear. He paused for a few seconds, chatted with the stewardess, then descended the stairway, entered through a restricted gate, grabbed Horace and hugged him.

"You look great!" Horatio exclaimed. "Army life must agree with you. Let me grab my bag and we'll be off."

From the airport to the Daleville motel, Horatio recited a continual spiel about his recent ordeals. He continued through dinner and while Horace escorted him to his room. Ears numb, poor Horace only managed to get in a hasty "Good night," though he was anxious to tell his father about his emergency landing.

Horatio proudly pinned wings on Horace and the commandant of the aviation school stepped forward. "As the distinguished graduate with top flight and academic grades, Mr. Frozzleforth, it gives me great pleasure to present you with this certificate of achievement and plaque on behalf of the Army Aviation School and the Association of the United States Army. Additionally, I present to you the Broken Wing Aviation Safety Award for the extraordinary skill, judgment and technique you displayed in coping with the engine failure during your first solo training flight in a UH-1B."

For the first time in his life, Horatio was completely dumbfounded. Why didn't the boy tell me about his achievements, he wondered. Then he smiled. Don't know why I should be so surprised, though. After all, Horace is a chip off the old block!

Thus begins the flying career of the younger Frozzleforth, destined to become in reality what his father had accomplished only through his oversized ego. Watch for Horace in future issues.

Does environment influence the behavioral patterns of aviators?

THE ACCIDENT ENVIRONMENT

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ENVIRONMENT IS said to be the aggregate of external circumstances, conditions and other factors that affect the existence and development of an individual, organism or group. Man is often described as a product of his environment since he is affected by it. Why, then, do some men experience accidents while others do not? Is this due solely to the psychology of accident victims themselves?

Extensive programs are conducted to determine man's reaction to stress and his ability to function in foreign environments. But very little is done about the everyday working environment of aviators . . .

THE ACCIDENT ENVIRONMENT

It is immediately apparent this is false logic. Man is not necessarily responsible for accidents resulting from such acts of God as lightning strikes, bird strikes and the like. These are rarely influenced by man, unless we say that man should not have been there in the first place. In the realm of aviation, perhaps we should have learned from Icarus and stayed on the ground with other primates in a two-dimensional existence. But it has never been man's nature to remain content. We have always wanted to imitate birds and leave our earth-bound confinement. Our success has been phenomenal, surpassing any known achievement of other animals. This success, however, has placed us in a whole new environment that effects us physically and mentally.

A great deal of effort is expended on environmental studies. Extensive programs are conducted to determine man's reaction to stress and his ability to function in foreign environments. But very little is done about the everyday working environment of individual aviators or groups of aviators. Does environment influence the behavioral patterns of aviators and ground crews? It most certainly does.

You need only to look at daily operations in the combat environment to see changes in behavioral patterns. Aviators fly more attentively when the enemy is firing at them. A very real sense of urgency exists in the minds of all personnel and mission accomplishment becomes paramount. The law of self-preservation also comes to the minds of aviators because a real danger they can readily identify exists. Let's remove that danger by moving a unit or aviator to a peaceful location, or by pacifying the area where they operate. This changes the operational environment considerably. The real dangers they knew in combat are no long apparent and the stage is set for what I will call *the accident environment.*

An accident is not inevitable until the last act that makes it happen has been performed. All accidents have a cause, but rarely does only one cause create an accident. Instead, an accident—by definition, an unplanned event—requires a series of circumstances or conditions to exist prior to the actual event. People create these circumstances and conditions. However, the person or persons who cause the circumstances or conditions for an accident may not be the victim of it. An innocent party is often the victim. The people responsible for these circumstances or conditions which influence others have created an accident environment.

How does this work? A unit may have a commander who is a very aggressive manager and anticipates every contingency which could affect his capabilities to accomplish his mission. He is mission oriented in his personal attitude and plans his operations for the most expeditious methods to reach his goals. This attitude of command permeates the entire unit and, if the desired results are achieved, the whole unit rightfully takes pride in their accomplishments. Small, insignificant events that do not stop planned operations may take place. These merely indicate small miscalculations or oversights took place. They could take the form of administrative errors in filing a flight plan or a missing tool now and then. Nothing came of them, so they were cast aside as minor mishaps. But were they? No positive corrective action was taken and no issue was made of the mistakes. Personnel aware of the mistakes develop a complacency about them, since the job was accomplished without accident.

More mistakes will follow and the attitude of complacency and procrastination will build, but not be identified. The unit will continue to accomplish its

mission because of motivation from pride and command leadership. There is a feeling of euphoria. They have had no accidents or incidents. Therefore, they believe they have a healthy, robust unit with high morale. In reality, they have a very sick unit as far as their operational environment is concerned.

A near miss by two of their aviators creates anxiety and fast-beating hearts which are calmed by an evening at the bar, but no analysis of the error is made. It is treated as a brief laxity on their part at which lady luck smiled. They do not realize the error is identical to one that results in midair collisions. They may make a token gesture and submit an operational hazard report, but that's the end of their concern.

This error will surely happen again. The terrible result next time may well be sudden death for several people. The accident has struck and the effect upon the unit is devastating. Suddenly, an extensive investigation is underway. Old procedures are found faulty. A general sense of carelessness is found to exist in the unit. Lack of command supervision is blamed for this tragedy. New controls are put into effect to remedy this situation and prevent more midair collisions. These are blood corrections, only taken after the fact. They are often the only way we correct our mistakes.

The unit will evaluate its operations in relation to this accident and some new faults may be found that can be corrected. However, a comprehensive examination of the attitude of the unit would likely disclose a feeling of "tough luck," or "I knew that guy would kill somebody sooner or later." The aviators do not realize that the accident could just as easily have happened to them because the environment was cocked and only a touch of the trigger was needed to cause the tragedy. If this attitude prevails, the accident will soon be forgotten or relegated to statistical data. Parts of the environment have been changed and the chances of a midair collision are lessened.

But what about the rest of the environment? Shortly after the unit returned to normal, an engine failure resulted in an accident with major damage. Again, the investigators were at work and, this time, foreign object damage was found to be the culprit. Remember the lost or missing tools? One went through the engine that failed. Small environmental factors are rapidly putting this unit out of business. The commander will realize this, since it's now apparent that his ability to reach his goals has been impaired due to resource losses. Now, he may thoroughly evaluate his whole unit. Again, he's a day late and a dollar short. The indicators for both accidents were present in the environment for a long time, but nobody was looking for them.

Good managers will identify their deficiencies early. They must be aware of the insidious nature of the accident environment. They must maintain a constant reading of the attitude of their organization. The smallest error is indicative of substandard behavior. Something is wrong. Careful analysis of all phases is required periodically. Bad situations do not correct themselves—they only continue to exist. These can and will compound circumstances and conditions which ultimately result in accidents.

The commander has a direct line to the attitude of his unit. He has a handy tool that, properly employed, can control the accident environment. This tool is a highly trained and motivated safety officer who can communicate with people. An officer who can identify hazards at all levels and use good common sense can control or eliminate hazards. Evaluate *your* organization. Look extremely close at your people's behavior and notice their attitude toward this complex business of flying. Are *you* operating in an accident environment?

USAASO Sez

The U. S. Army Aeronautical Service Office discusses

Use of preferred routes

New terminal refresher training pamphlets

The availability of TB 95-1

Use Of Preferred IFR Routes: Let's give the controllers a break by using the enroute preferred routes. We are all interested in the same results: safety and the smooth orderly flow of air traffic.

To achieve this desirable goal, the use of enroute preferred routes is encouraged. A system of preferred routes has been established to guide pilots in planning their route of flight, to minimize route changes during the operational phase of flight and to aid in the efficient management of the air traffic using federal airways. The preferred IFR routes (FLIP, section II, or AIM, part III) are designed to serve the needs of airspace users and to provide for a systematic flow of air traffic in the major terminal and enroute flight environments. Cooperation by pilots in filing preferred routes will result in fewer traffic delays and will provide for efficient departure, enroute and arrival air traffic service.

When the pilot has determined that adverse weather exists along a preferred route (by checking weather reports and forecast displays in the weather station) he may select an alternate routing and add in the "Remarks" section of the DD 175 where and what adverse conditions are forecast.

For such purposes adverse weather is defined as clear air turbulence (CAT), thunderstorms (TSTM) or head winds (HDWND)—winds that will delay your flight to destination by 15 minutes. Example: Conyers intxn, V-66 Fort Mill, V-454 Lawrenceville, V-157 Ironside intxn is the preferred route from Atlanta to Washington, D. C. If thunderstorms are forecast in the Athens, Ga., area, a notation will be made in the "Remarks" section of the DD 175 "TSTM in Athens area." Only information essential to safe and efficient control of air traffic will be placed in the "Remarks" section.

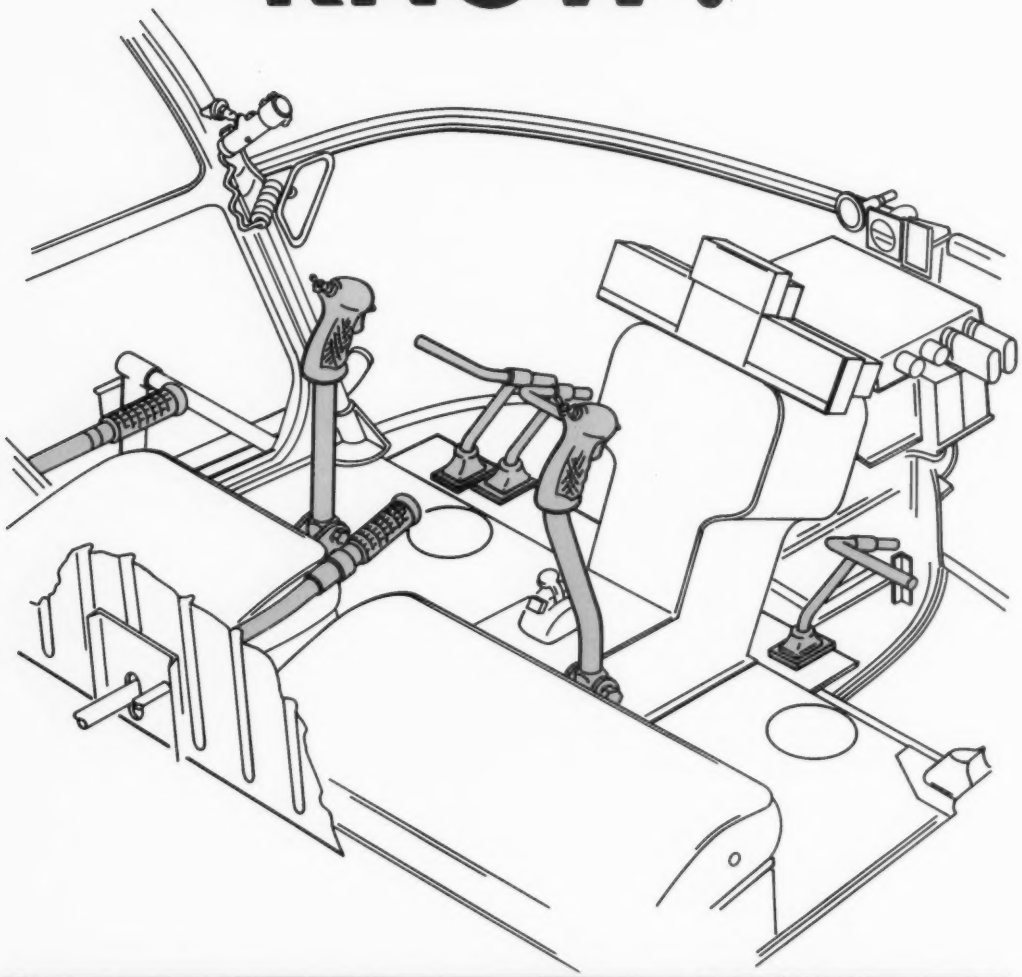
While the filing of preferred routes by pilots is not mandatory, the importance of understanding the preferred enroute system cannot be overemphasized. Let's use them!

Attention ATC Facility Chiefs: FAA has just distributed new terminal (green cover) refresher training pamphlets. The date on the cover is 1 January 1970. These training pamphlets are an excellent aid to be incorporated in your training program. One suggested way to utilize these aids is to remove the answer sheet and have all of the controllers take the short quiz and grade them. It will be an eye opener.

TB 95-1: We've been keeping the presses rolling on USAASO publications. Our latest is Technical Bulletin 95-1, U. S. Army Air Traffic Control and NAVAID Facility Standards, dated 19 February 1970. The TB is aimed at standardizing ATC and NAVAID facilities at nontactical Army airfields. Each Army airfield should receive two copies, so be on the lookout for yours.

Now let's see, it said to lay the map flat, north at top, face up, then fold . . .? Guess I'd better check the story on page 10 again

DO YOUR PASSENGERS KNOW?



BRIEF ALL PASSENGERS ON THE DANGERS OF TOUCHING CONTROLS

prepared by the U.S. Army Board for Aviation Accident Research

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